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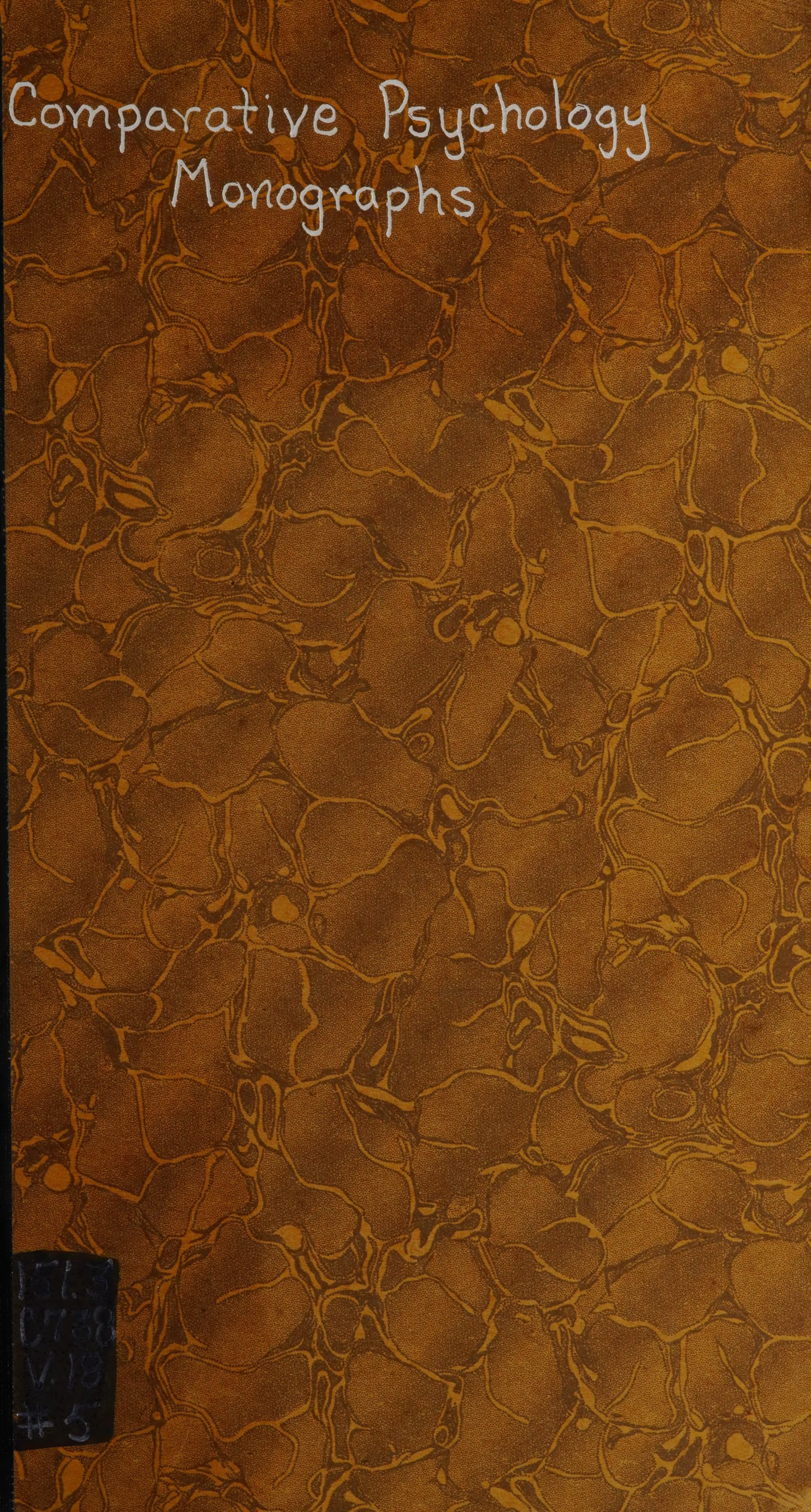

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he Explanations of Physical Phenomena Given by White and Negro Children

F. NOWELL JONES
And
MARION GRAVES ARRINGTON
University of Alabama

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THE EXPLANATIONS OF PHYSICAL PHENOMENA GIVEN BY WHITE AND NEGRO CHILDREN[1]

F. NOWELL JONES AND MARION GRAVES ARRINGTON

University of Alabama

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I. INTRODUCTION

One of the most persistent stereotypes which white Americans have concerning the Negro is the opinion that he is childish and superstitious in his reasoning processes. Thus, Guy Johnson (in Klineberg, 12) is able to list as one of the "common-sense observations" prevalent concerning the Negro a ". . . high interest in 'superstition'—i.e., belief in various supernatural forces and ways of controlling them" (p. 19). Blake and Dennis (4) have reported that the Southern high school students whom they studied were unanimous in their agreement that Negroes are more superstitious than whites.

If such a tendency to appeal to superstitious or supernatural agencies could be shown actually to exist more generally among Negroes than among whites, this fact would have great theoretical and practical importance. If, on the other hand, it could be shown that such a difference in quality of reasoning does

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[1] We wish to thank the teachers in the white and Negro schools who cooperated so willingly with us during the collection of the data. We wish especially to thank Dr. H. G. Dowling, former Superintendent of Tuscaloosa City Schools, for permission to work in the classrooms, and Dr. H. C. Pannell, present Superintendent, for permission to publish our results. No one but the authors, however, is responsible in any way for their interpretations.

not exist, contentions that differential treatment-educational and occupational—should be given the Negro on this account would be confuted.

It would not be possible to decide completely an issue such as this by the study of existing population groups. The impossibility of obtaining comparable samples of the two racial groups has been made clear elsewhere (Canady, 7; Klineberg, 12). In addition to the problem of sampling, there remains the fact that the performance of a group of people depends in appreciable magnitude upon the cultural milieu in which the group exists, and in which the responses are elicited. This latter point need not be fatal to our inquiry, however. It is true that a positive result, that is, the demonstration of a difference between the races in manner of reasoning, would be rendered equivocal by these cultural factors. Nevertheless, a negative or nearly negative result would still possess significance. If a demonstrable difference does exist, it may or may not be ascribable to cultural, including educational, factors. One could not say, on the basis of the bare results with existing population groups, that the Negro was or was not inherently childish and prone to superstitious reasoning. On the other hand, the finding of no difference, or of a small difference in response would strongly suggest the conclusion that no inherent difference existed, within the limits of the method of investigation.

II. OTHER STUDIES

In view of the excellent summary of the results of the use of intelligence tests with Negro subjects which now exists (Klineberg, 12), it is not necessary to explore this topic here. There are a few studies, however, which do not relate primarily to "intelligence," and which contain conclusions which we feel deserve examination.

Investigations relating to the reasoning of Negroes divide themselves roughly into two types. In one type of study, standard intelligence tests are subjected to item and other analyses for the determination of varying patterns of proficiency or deficiency. The earlier studies of this type are summarized by Klineberg (12) and Machover (17), and will not be considered in detail here. There would seem to be no invariable result which has been found with sufficient frequency to warrant its acceptance.

In the other type of study, specific techniques are employed which are designed to elicit responses resulting from one or another variety of "thinking" or "reasoning." We shall first consider the more recent experiments of the first, or intelligence test variety.

Bean has published two studies in which the results of intelligence testing are applied to the general problem of reasoning. In the first of these a general discussion of Negro ability is presented (2). It is pointed out, undoubtedly rightly, that the usual intelligence test is not fair to the Negro subjects because of their divergent background of experiences. Bean then discusses the reasoning ability of Negroes, with his conclusions apparently based primarily on casual observation. Examples of his opinions are, "In following instructions, Negroes are notoriously deficient" (p. 196), and, "Another interesting characteristic of Negro thinking is the inability to pick out the essential from the non-essential elements in a situation." Unfortunately for our purposes, these statements are not backed up by objective data. As will be obvious when we consider the results obtained from our investigation, the latter of the quotations given above is not substantiated, but we have not studied directly the problem of ability to follow instructions.

In his second paper (3), Bean concludes:

> This study has shown that the group of Negroes tested is distinctly inferior to whites of the same age in thinking ability with verbal and non-verbal problems involving classification, arrangement, and relationships. There is considerable probability of a small, but reliable difference in favor of non-language material, but these Negroes do not fail in intelligence test items merely because of lack of vocabulary or comprehension of complex sentence structure. Fundamental capacity to reason is probably low in most of the members of this group (3, p. 349).

The group referred to in the quotation above consisted of twelve Negro boys and thirty-seven Negro girls in the eighth grade of a Baton Rouge school. The retardation of the members of this group was very great when their scores were compared with the norms for the Otis Intermediate Test and the Minnesota Paper Form Board. It should be emphasized that no "control" group was included in this study, and so we cannot decide how much of the obtained inferiority might be shared by white children reared in the same locality. It is interesting to note the relatively greater inferiority in verbal performance, but we cannot draw any final conclusions concerning the absolute level of performance on the basis of these results. In justice to the racial group under consideration, it should be pointed out that the "inductive leap" from scores on paper-and-pencil tests to "fundamental capacity to reason" is a long one.

A recent study by Machover (17) is concerned with the general problem of finding whether or not Southern Negro criminals, Northern Negro criminals, and Northern white non-criminals differ in the distribution of scores on the subtests of the Bellevue Adult Scale. Since his groups were matched for age, composite test ability, and level of schooling, any over-all difference in level of ability was controlled. Differences in relative standing on certain subtests were found, however, with the scores favoring the white in arithmetical reasoning and digit retention, and favoring the Negroes in similarities. That the block design test yielded no difference is particularly interesting in view of the results obtained by Goldstein and Scheerer (9) with this type of test in the study of abstract and concrete performance. It should be emphasized that these results tell us nothing of the relative standing of the groups in general efficiency, and it might well be that the fluctuations of the Negroes' subtest scores were occurring around an average many points higher or lower than the white mean. Although this limits the conclusions to be drawn from this experiment, from our point of view, our remarks are not criticisms of Machover's study, since he was not interested in the general levels of his groups.

Peterson (18), and Peterson and Lanier (19) have published investigations of particular interest to us. These studies are examples of our second type, and were designed to test certain aspects of white and Negro thinking by the use of specific tests rather than by intelligence tests. Peterson's 1923 study was a very thorough one of scholastic success, intelligence, and other aspects of the Negro child's abilities. We are interested primarily in the results obtained from the administration of the "rational learning" test. On the basis of the results of this test, as administered to eight-, nine-, and ten-year-olds in the South, Peterson states, ". . . there seems to be a fair degree of evidence to indicate, though there is not yet proof of it, that the chief deficiencies of the negroes do lie along the line of abstract thinking, logical analysis, and mental reconstruction" (18, p. 137). In support of this conclusion, Peterson points to the learning curves of the white and Negro children, since:

> The number of errors increases with lack of attention to the essential associations and the consequent lack of organization of the data in each repetition. The number of letters is so small in this test that a keen analytic mind can easily avoid repeating erroneous guesses in any one repetition. We must conclude, therefore, that the Negro lacks more in rational organization and in the perception of the essentials of a complex situation than he does in memory. This is in general agreement with the results of other researches, but it is particularly significant here because in this case the children were made to face a complex learning problem, one, moreover, that is practically free from influences of past experiences (18, pp. 115–117).

The results of the investigation by Peterson and Lanier (19) show how wrong was the belief that the rational learning test is free from the influences of past experiences. Peterson and Lanier administered the rational learning test to twelve-year-old white and Negro children in Nashville, Chicago, and New York. Other tests were also used, but since this was the only test of its general kind used in New York, we shall confine our attention to it. It was found that the Negroes were generally inferior to the white groups in Nashville and Chicago, both in total time consumed and in number of errors made. So far, this confirms Peterson's earlier results. In the case of New York, however, the picture is quite different. The whites consumed only slightly less time, and the Negroes required reliably fewer repetitions, and made reliably fewer errors. Peterson and Lanier are not inclined to interpret the superiority in error scores displayed by the New York Negroes as being due to superior thinking on the part of the Negroes. Their statement is as follows:

> In one respect these results agree with those from Nashville and Chicago where the negro was found to require fewer repetitions than the white. (Note: Their Table 16 shows that the Chicago Negroes required more repetitions than did the Chicago whites, so that this statement is not entirely correct.) This result was interpreted to mean that the negro had better memory ability, but was slower in reaction time, than the white child. The same thing is found in New York, where the negroes actually make fewer errors. Superficially, this latter result might seem to indicate greater deliberation on the part of the negro, and a consequent smaller number of 'random' reactions. We are not inclined, however, to interpret this slowness as meaning deliberate forethought, but rather as signifying a real mental lethargy. This may seem inconsistent with the fact that the negroes made fewer erroneous reactions than the whites. The latter, however, seemed more responsive to the stimulus of having the experimenter wait for an answer, and probably were more often led

> into error by over-anxiety than were the negroes. This high degree of impulsion and sensitivity to 'social stimulation,' although resulting in premature and inconsistent reactions, tends to produce stronger motivation in the white and a quicker solution of the problem at hand. These are probably temperamental differences between the two races of very great importance, although the desirability of more evidence on this point is evident. Numerous other studies have found the negro slower than the white (19, p. 69).

This statement is supported by the greater number of words given in three minutes by the New York whites, during the administration of the Yerkes Point Scale. On the other hand, Peterson and Lanier argue in another place, "The number of errors in any repetition—barring effects of excitement—probably varies inversely with the subject's ability to react rationally to the situation, i.e., to respond to it by insight rather than by accident or guess, while the number of repetitions required for complete learning seems to be more largely dependent on mere memory" (19, p. 71). On this basis, the New York Negroes are superior to all other groups, with the possible exception of the Nashville whites, with whom they are at least equal, as an examination of Peterson and Lanier's Table 23 will show. The New York Negroes made a smaller median number of errors than any other group on the *first trial*, for which the statement from Peterson and Lanier would hold most strongly. In addition, this superiority is very much increased on each successive trial.

It should be pointed out that Peterson and Lanier do not argue that the differences that they believe exist are innate. They feel that speed, particularly, is determined by the mode of life to which the individual has had to adapt. In a further analysis of these data, Lanier (15) reaches a somewhat different conclusion. Here he states, "We cannot assert, in the absence of more comprehensive results, that this speed difference represents a real race difference but in view of the fact that it exists in New York where environmental factors are perhaps most favorable to the Negro, and where his total performance otherwise equals or excels that of the white, there appear to be sounder grounds for claiming that this is a real race difference than exist for such an assertion based upon any other results reported here" (15, p. 217). On the other hand, the slight superiority of the Chicago Negro group in speed is possibly to be explained thus: "The fact that these Chicago negroes were slected from supervised playgrounds where considerable emphasis was placed upon speed in competitive games may explain their better speed scores" (15, p. 217). Apparently, then, this "real race difference" is not immune to environmental alteration.

Recognizing the need for further data, Lambeth and Lanier (14) have administered several tests to thirty white and thirty Negro twelve-year-olds in Nashville. They report that the Negro's inferiority in speed increases with the complexity of the task, and tacitly abandon Lanier's earlier position. Since our investigation is not concerned with "speed" as a measurable variable, we are more interested in the comments made by Lambeth and Lanier concerning the organization of test performance in the two racial groups. They find higher intercorrelations among scores made by the Negroes than among those made by the whites. They cannot decide whether either or both of the factors, ". . . (2)

the presumably more 'diversified' environment of the white, and (3) the Negro might represent a more 'primitive,' less differentiated type of organization of behavior traits" (14, p. 294), is responsible for the obtained results. Another possible explanation might be the existence of a factor influencing the Negro's scores which did not exist for the white children. An example of such a factor would be fear of the white experimenter. If any factor such as this obtained in varying degrees among the individual Negro children, spuriously high correlations would result. Our own investigation cannot settle this issue, but, as will be seen, we have not found evidence of striking differences of organization of performance.

Bruce (5) has made a specific attempt to investigate the development of "animism" in white and Negro children of rural Virginia. She finds that the same "stages" of animism appear in both races, although the Negro children are, perhaps, somewhat retarded in their passage through these stages. The exact significance of this result must depend upon the significance of stages of animism in general. The question of the theoretical place of animism in the development of reasoning in the child is not settled, and so final judgement must be deferred. (For contrasting views *cf*. Huang, 10; and Russell, 21.) Bruce's approach is an interesting one, however, and might well be extended.

III. THE PROBLEM

It is evident that direct approaches to the ability of the Negro to reason are not many. For this reason, it appeared to us that an investigation designed to display qualitative as well as quantitative aspects of performance was needed. Partly because school children are more readily available as subjects than are adults, and partly because we believed that age trends might be of importance, we determined to carry out an investigation of the explanations given physical phenomena by white and Negro children. It would be impossible, of course, to eliminate cultural complications. Nevertheless, it was felt that by eliciting responses to relatively novel situations, under circumstances designed to capture the interest of the children, opportunity might be provided for superstitious and supernatural explanations to appear, if tendencies toward them existed, even though one group or another might be handicapped by lack of certain items of specific information. We hoped to avoid providing the children with opportunities for learned, verbalized superstitions to appear. Thus, neither group could be categorized as "superstitious" or "childish," as compared to the other, merely because of the running off of previously acquired habitual responses.

IV. METHOD

1. *Material*

Although there are objections to the use of a group situation, the practicality of such an approach was considered adequate as a justification for its use in a partially exploratory study such as this. So that our results might be compared to those of other investigators who have studied reasoning in children, it was decided that the physical demonstrations used by Deutsche (8) in her study of the growth of reasoning in school children might be readily adapted to our use. In general, this technique involves the demonstration of some simple physical phenomenon, as, for example, the rising of the water in a glass when a pebble is dropped into it, followed by the instruction to the children that they are to write out an explanation of the occurrence. This general method began, of course, with Piaget (20), although he did not work with groups, but with individual children. We have followed rather closely the methods used by Deutsche in nearly all of the ten demonstrations we have used. Her test No. 11 was not used. For the reader's convenience, we have outlined very briefly the various tests, and have noted the divergences from Deutsche's methods.

1) Candle-in-jar. A glass tumbler was placed over a burning candle, which then gradually went out. Question: Why does the candle go out?

2) Penny-in-box. A penny was placed in a small cardboard box which had strings attached to the four corners. The box was then swung vertically by means of the strings, after the fact that the penny would fall out of the unmoving box when it was inverted had been demonstrated to the children. Question: Why doesn't the penny fall out?

3) Level-of-water. A large pebble was dropped into a beaker partly filled with water. Question: Why does the water come up higher when I put the pebble in?

4) Block-dropping. A small, brightly colored wooden block was dropped onto the table from a height of about two feet. Question: What makes the noise when the block falls?

5) Changing-color-of-liquids. A few drops of bromcresol green were placed in a beaker of water. Now a few drops of hydrochloric acid were added. In another beaker, this experiment was repeated with methyl red and hydrochloric acid. Question: What makes the water change color when I pour in some of this colorless stuff?

6) Bulb-on-tube. Water from a beaker was drawn into a long glass tube by squeezing and releasing a rubber bulb on the upper end. (Deutsche here used an hydrometer.) Question: What makes the water go up in the tube when I let go of the bulb?

7) Teeter-totters. Two small, brightly colored blocks of equal size were placed on opposite ends of an equal-armed teeter-totter or lever. After the balance had been demonstrated, the two blocks were placed on an unequal-armed lever, and the lack of balance was shown. Finally, a large block was shown to balance a small one on the unequal lever. Question: Why do I have to put a big block on one end to make this teeter-totter balance?

8) Mixed-liquids. A closed test tube filled with water, methyl red, and carbon tetrachloride was thoroughly shaken in the full view of the children and then permitted to stand on end for a few moments. Question: Why does the colored liquid separate from the colorless liquid?

9) Paper-over-jar. A glass tumbler full of water was covered with a piece

of unglazed paper and inverted. Question: Why don't the paper and water fall out of the jar?

10) Musical-instrument. In this case, we have deviated quite considerably from Deutsche's technique. A Ludwig Song Whistle was used to produce sounds of various frequencies. This instrument consists of a foot-long barrel of small bore, and a sliding stop which can be manipulated by means of a rod protruding through the lower end of the instrument. When one blows into the barrel through the mouthpiece, the frequency of the resulting sound depends primarily upon the position of the stop. This stop was manipulated up and down to produce sounds of varying frequency. Question: Why does it make different sounds when I put the slide in different places?

2. *Subjects*

The subjects were all children in the Tuscaloosa, Alabama, city schools. In all, there were 134 white subjects in grades three, four, and five of one elementary school and grade seven of the junior high school, and 161 Negro subjects in the same grades of a Negro school. The schools used were selected on recommendation of the superintendent, who felt that they would give the best samples of the city as a whole. Table I shows the distribution of children by sex and color within each grade. It should be noted that a few white children were in grade eight, but since the primary analysis of our data was made by age rather than grade, their scores have been included. This will affect only the 15–16 year scores, and it will be seen that this inclusion has no effect upon our general conclusions.

TABLE I

The distribution of children by race, grade, and sex

GRADE	NEGRO		WHITE	
	Boys	Girls	Boys	Girls
8			7	7
7	12	28	9	15
5	15	26	13	19
4	21	22	15	17
3	18	19	19	13
Totals	66	95	64	70
	161		134	

3. *Procedure*

The experiment was conducted entirely in the various school classrooms. The three lower white grades were tested in one day, and the seventh grade was tested three days later. One week later, the Negro classes were tested. There seemed to be no evidence of prior knowledge on the part of the grades tested last.

After the experimenter (Arrington) had been introduced to the children by the teacher, a general explanation of the nature of the demonstrations was given, and it was made clear that the children were not to be graded, but that their opinions about the experiments were desired. A set of mimeographed sheets was passed to each child, which bore the various questions as given above, with space for the insertion of the answers. The demonstrations were now given, and the time was provided after each for the children to write down their explanations. In the lower grades, the teacher and the experimenter gave help in spelling where necessary. Silence was insisted upon, to prevent the suggestion of answers. The complete series of demonstrations required about one hour.

One demonstration, No. 5, failed in two Negro grades, the fifth and seventh. The analyses are therefore based on a restricted sample for this question. This effect is felt primarily at the upper age levels, where only the retarded older Negroes are included.

We believe that we obtained a large measure of cooperation from the children. The experimenter was usually besieged with questions at the end of the experiment, and one Negro class stayed half an hour after school to discuss the demonstrations. How much the fact that the experimenter was white affected the rapport with the Negro children is a matter of conjecture, and will be discussed more fully in a later section. The white seventh grade was the sole exception to the general responsiveness noted, and these children seemed to display less interest than the others. Whether or not this actually affected their scores is impossible to estimate.

4. *Sampling*

No intelligence tests or ratings of socio-economic status were given. As applied to Southern Negro subjects, neither type of measure can be said to have any large degree of meaning. This is a trite observation as far as intelligence tests are concerned, and the discussion by Canady (7) demonstrates very adequately the point made concerning socio-economic scales. Any attempt to match groups in this experiment on the basis of I.Q. or socio-economic status would result in the comparison of average or superior Negro children with the lower white groups. Therefore, every effort was made to select schools for study which would give good samplings of the white and Negro children of the community. That this method gives a perfectly adequate sample is not asserted. It is felt, however, that this technique gives as good a sample as can be obtained.

Since there has been a considerable amount of white intermixture with the Negro groups, the Negro sample would represent varying degrees of "purity" of the Negro stock. This is a factor which is not susceptible to adequate control, since "pure" Negroes will represent a range of Negroid characteristics such as skin color, thickness of lips, and so on. Any correlation between "Negroid" characteristics and performance is subject to this immediate attenuation. Furthermore, it is becoming apparent that tests of intelligence (12) and of more complex mental tasks (19) do not correlate with measures of Negroid characteristics. We have preferred, therefore, to confine our attention to a sample of the Southern Negro population as it exists today.

5. *Age Records*

The children's ages were obtained from them, and probably contain inaccuracies. This is particularly true of the Negro children (Peterson, 18). Peterson's results (18, p. 100) indicate accuracy in about 80% of cases, and errors of less than one year in 90%. We are given a measure of confidence that our obtained ages were no more inaccurate than this by two facts. First, the age trends which we have obtained are, when analyzed, generally regular and in the expected directions. Second, the degree of scholastic retardation shown by the Negroes, about 1.5 years in the lower grades, is approximately that to be expected (*cf.* Peterson and Lanier, 19).

V. QUANTITATIVE ANALYSIS

The answers obtained from the children were analyzed quantitatively and qualitatively. The quantitative analysis is given below, and the qualitative results are discussed in a later section.

1. *Scoring*

Each answer was scored for accuracy of explanation according to the following schedule:

7. Correct answer—all essential principles mentioned or implied, and the proper relationships explained.

6. Very good—slightly less than correct. Not all essential principles in proper relations, or incomplete explanation.

5. Good—one principle and relation correct at least, but not necessarily the essential ones.

4. Fair—some sense of true relationships, inadequate explanation of the relation.

3. Inadequate—principles inadequate or incorrect, or relationships inadequately or incorrectly expressed.

2. Very inadequate—principles involved incorrect and inadequate, yet on right track, i.e., appealing to proper agents, etc.

1. Incorrect—some answer, but entirely wrong in principles, relations, and agents.

0. Omitted, incomplete, "don't know," or incomprehensible.

It will be observed that this scale is copied from Deutsche (8). There is no assurance, however, that our judges have interpreted this scale as did hers. We shall also see that our statistical treatment deviates from that used by Deutsche.

There were five judges, three of them members of the faculty of the Psychology Department, one senior major in psychology, and one who possessed the master's degree in psychology.[2] Each answer was read to these judges, and each judge rated the answer independently, although some discussion occurred when doubt arose as to the basis on which numbers were to be assigned. There is no assurance that every judge followed the exact description of the scale as outlined above, but there is no doubt that the ratings were distributed up and down the scale in such a manner that the better answers would consistently receive the higher ratings. No judge knew at any time whether the answer being rated was from a white or Negro child, or from a lower or higher grade. All the answers to a given question were rated before the next question was considered. There was, therefore, no possible tendency for all the answers of any one group to be rated near the beginning or end of the rating process. Usually about two or three sets of answers could be rated during one evening session, so that a total of four evenings was required. In order to stabilize the judgements as much as possible, a set of theoretically correct answers was provided for each judge. These answers had been checked for accuracy by the chairman of the Physics Department.

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[2] We wish to thank Professor D. A. Ramsdell, Dr. Donald Du Bois, Mr. Thomas McLure, and Mrs. Margaret Hubbard Jones for their kindness in acting as judges. The fifth judge was the senior author.

TABLE II

The range and average of ages for each grade

GRADE	NEGRO		WHITE	
	Range	Average	Range	Average
8			13–16	14.3
7	10–15	13.3	11–15	13.0
5	9–15	11.7	9–12	10.6
4	9–15	11.3	8–11	9.3
3	8–12*	9.6	8–9*	8.2
Total sample.....	8–15	11.4	8–16	10.5

* In both racial groups, there were two seven year olds in grade three. These have been omitted from our investigation.

The score finally assigned to a given answer was the mid-score of the five judges' ratings. This method of deriving the final scores eliminated the possibility that any one divergent rating could affect the result. In order to determine the consistency of the ratings, the average range of scores for each answer was calculated. This was 1.2 both for the Negro and the white answers. In the case of 92% of the white answers and 93% of the Negro answers, the highest score assigned by any judge differed from the lowest score assigned by any judge by two or fewer scale points. This would indicate a fairly high degree of consistency, since the average range represents an extreme measure of deviation. It should also be noted that zero scores were not included in this calculation.

2. *Results*

The two variables which are acting upon the two racial groups, and which we can measure, are scholastic standing, or school grade, and chronological age. The discrepancy between the two groups in scholastic standing at a given age is rather large, as is shown in Table II. It will be seen that the Negroes are relatively retarded at every grade-level except the seventh, by which time the more retarded Negroes, that is, those over fifteen, seem to have left school. Moreover, there are Negro children of almost all ages, including fifteen, in every grade. It is apparent, therefore, that an attempt to equate schooling would result in the comparison of relatively old Negro children with the younger white children. On the other hand, an age-analysis would be unfair to the Negroes, since their scholastic retardation would tell against them. Unfortunately, this latter factor cannot be eliminated completely. In order to obtain an empirical picture of the Negro-white relationships, we have chosen to give most of our analyses, such as sex differences, in terms of age. The grade-level relationships will be considered specifically under the heading of racial comparisons, and scholastic achievement is treated as a cause of the observed differences in our investigation.

TABLE III

Scores on question 1 at each age level

Age	8	9	10	11	12	13	14	15–16
White								
Boys	4.1	4.1	4.6	4.9	5.3	5.3	5.0	5.0
Girls	4.6	4.6	4.0	4.8	4.3	4.9	4.8	5.3
Total Av.	4.3	4.4	4.3	4.9	5.0	5.1	4.9	5.2
Total S.D.	0.91	1.20	1.22	0.66	0.50	0.59	0.32	0.41
Negro								
Boys	3.8	3.2	3.8	4.8	4.1	3.8	4.0	5.3
Girls	4.3	3.9	4.7	4.6	3.8	4.8	4.2	3.4
Total Av.	4.0	3.6	4.4	4.6	3.9	4.4	4.2	4.3
Total S.D.	1.20	1.50	1.21	1.13	1.75	1.37	1.40	1.55
Difference, White-Negro	0.3	0.8	−0.1	0.3	1.1	0.7	0.7	0.9
t	0.75	*2.05*	−0.31	0.92	*1.70*	*1.88*	1.54	1.38

Where the t scores are sufficiently large to indicate probability at the 5% level the scores are italicized, and where they indicate probability at the 1% level they are starred (*).

a. *Sex Differences.* Since we have grouped together the scores of the two sexes in making our racial comparisons, it is necessary to determine whether or not this procedure is justified. For this purpose, we shall consider the sex differences found.

Tables III through XII and Figure 1 show the Negro and white averages for the ten questions by age. In the tables, the sexes are listed separately and the t scores found for the differences between the Negro and white averages are shown. The discussion of the racial comparisons will be found in a following section. Figure 2 shows the combined scores made by the white and Negro boys, and by the white and Negro girls. The sex differences appear to be sporadic and inconsistent in direction. There is no question on which either sex is superior at every age-level. The results published by Deutsche (8, p. 34) are not unlike ours, although she finds a greater trend toward masculine superiority than do we. In 46 of the possible 80 comparisons in our experiment, the boys were superior. The girls showed superiority in 29 cases, and 5 were equal. This shows a moderate tendency for the boys to give better answers. An analysis of

TABLE IV

Scores on question 2 at each age level

Age	8	9	10	11	12	13	14	15–16
White								
Boys	2.8	3.0	2.8	3.0	4.0	4.0	2.5	3.3
Girls	2.2	2.0	2.6	2.3	3.2	3.8	3.2	2.3
Total Av.	2.6	2.4	2.7	2.7	3.4	3.9	2.9	2.8
Total S.D.	1.41	1.60	1.37	1.27	1.15	1.40	1.11	1.33
Negro								
Boys	1.6	1.8	2.6	2.7	2.5	3.0	2.7	2.2
Girls	2.0	2.0	1.7	2.1	2.0	2.6	2.6	2.1
Total Av.	1.8	1.9	2.0	2.3	2.2	2.7	2.6	2.2
Total S.D.	0.89	1.13	1.30	1.29	1.27	1.19	1.63	1.28
Difference, White-Negro	0.8	0.5	0.7	0.4	1.2	1.2	0.3	0.6
t	1.56	1.19	*1.79*	0.96	2.59*	2.92*	0.55	0.97

The *t* scores are given as explained for Table III.

TABLE V

Scores on question 3 at each age level

Age	8	9	10	11	12	13	14	15–16
White								
Boys	3.1	2.6	3.5	3.2	5.0	4.3	3.2	4.3
Girls	2.5	3.2	3.1	3.2	3.0	3.7	4.2	5.3
Total Av.	2.9	3.0	3.3	3.2	3.7	3.9	3.8	4.8
Total S.D.	0.85	1.02	1.31	1.31	1.32	1.53	1.23	1.17
Negro								
Boys	2.8	2.9	3.1	1.9	3.4	2.8	3.0	2.7
Girls	2.7	2.7	2.6	2.9	2.9	3.2	3.6	3.7
Total Av.	2.8	2.8	2.8	2.9	3.1	3.1	3.5	3.2
Total S.D.	0.89	1.17	0.83	0.90	1.41	1.18	1.15	1.59
Difference, White-Negro	0.1	0.2	0.5	0.3	0.6	0.8	0.3	1.6
t	0.28	0.63	1.55	0.67	1.14	*1.89*	0.56	*2.19*

The *t* scores are given as explained for Table III.

this kind was also carried out for the two races separately. The white boys were superior to the white girls 47 times out of 80, the girls were superior 28 times, and the two sexes made equal scores 5 times. The Negro boys did not show even this degree of superiority, since they excelled the Negro girls in only

TABLE VI

Scores on question 4 at each age level

AGE	8	9	10	11	12	13	14	15–16
White								
Boys	1.8	2.1	1.8	2.2	2.3	2.2	2.8	3.3
Girls	2.0	2.1	1.9	2.0	2.0	1.9	2.3	2.3
Total Av.	1.8	2.1	1.8	2.1	2.1	2.0	2.5	2.8
Total S.D.	0.38	0.40	0.64	0.54	0.33	0.76	0.53	1.60
Negro								
Boys	1.8	1.9	2.0	2.0	2.2	2.1	2.0	2.0
Girls	2.0	2.2	1.9	2.1	2.2	2.0	2.0	2.0
Total Av.	1.9	2.1	2.0	2.0	2.2	2.0	2.0	2.0
Total S.D.	0.36	0.42	0.55	0.42	0.59	0.59	0.00	0.41
Difference, White-Negro	−0.1	0.0	−0.2	0.1	−0.1	0.0	0.5	0.8
t	−0.65	0.0	−1.15	0.68	−0.48	0.0	3.15*	1.73

The *t* scores are given as explained for Table III.

TABLE VII

Scores on question 5 at each age level

AGE	8	9	10	11	12	13	14	15–16
White								
Boys	1.4	1.4	1.7	1.8	2.7	1.8	1.8	1.3
Girls	1.4	1.8	2.1	1.3	2.0	1.2	1.3	1.0
Total Av.	1.4	1.6	1.9	1.6	2.2	1.5	1.5	1.2
Total S.D.	0.65	1.14	1.15	1.02	0.83	1.46	1.64	1.33
Negro								
Boys	1.8	2.1	1.7	1.3	1.5	2.8	2.0	1.3
Girls	1.7	1.3	1.6	1.8	1.8	1.0	0.0	
Total Av.	1.8	1.7	1.6	1.7	1.6	2.4	1.0	1.3
Total S.D.	0.47	0.92	0.62	0.58	0.68	2.08	1.00	0.58
Difference, White-Negro	−0.4	−0.1	0.3	−0.1	0.6	−0.9	0.5	−0.1
t	−1.60	−0.96	0.98	−0.35	1.69	−1.02	0.40	−0.12

The *t* scores are given as explained for Table III. The Negro sample is restricted because of the failure of this demonstration in their grades 5 and 7.

34 of 79 comparisons (79 because we have no responses from Negro girls aged 15–16 for Question 5), while the Negro girls excelled in 35 comparisons, and 10 were equal.

TABLE VIII

Scores on question 6 at each age level

Age	8	9	10	11	12	13	14	15–16
White								
Boys	1.9	1.4	2.6	2.0	3.3	3.0	2.5	2.7
Girls	1.6	1.6	1.8	2.3	1.8	2.0	2.7	2.7
Total Av.	1.8	1.5	2.2	2.1	2.3	2.4	2.6	2.7
Total S.D.	0.70	0.72	0.94	0.66	1.12	0.98	0.70	0.52
Negro								
Boys	1.6	1.8	2.0	1.8	2.1	1.8	1.7	2.3
Girls	1.7	1.9	1.7	1.9	1.9	2.0	1.9	2.0
Total Av.	1.6	1.8	1.8	1.8	2.0	1.9	2.0	2.2
Total S.D.	0.52	0.52	0.59	0.70	0.87	0.88	1.00	0.80
Difference, White-Negro	0.2	−0.3	0.4	0.3	0.3	0.5	0.6	0.5
t	0.74	−1.54	*1.73*	1.34	0.85	*1.70*	1.58	1.39

The t scores are given as explained for Table III.

TABLE IX

Scores on question 7 at each age level

Age	8	9	10	11	12	13	14	15–16
White								
Boys	1.7	1.7	2.2	2.4	3.0	2.7	3.0	2.0
Girls	2.0	2.2	2.5	2.2	1.5	2.6	3.2	3.0
Total Av.	1.8	2.0	2.4	2.4	2.0	2.6	3.1	2.5
Total S.D.	0.59	0.88	1.04	0.84	1.12	0.74	0.57	0.89
Negro								
Boys	2.0	1.9	2.0	2.1	1.9	2.0	2.7	2.8
Girls	2.0	1.9	1.6	2.0	2.1	2.3	2.5	2.9
Total Av.	2.0	1.9	1.7	2.0	2.0	2.2	2.5	2.8
Total S.D.	0.00	0.47	0.68	0.57	0.93	0.74	0.69	0.56
Difference, White-Negro	−0.2	0.1	0.7	0.4	0.0	0.4	0.6	−0.3
t	−0.95	0.45	2.72*	1.94	0.00	*1.68*	*2.16*	−0.93

The t scores are given as explained for Table III.

The reason for the lack of masculine superiority among the Negro children is not readily apparent. It is quite possible that the white boys are more apt to have commerce with various "gadgets," chemistry sets, and so on. It is also quite possible that there is no consistent masculine superiority, and the obtained superiority of the white boys is happenstance. This possibility is made more credible by the fact that the pattern of male superiority found by Deutsche (8, p. 34) is by no means the same as that found by us. The point remains unsettled, however.

TABLE X

Scores on question 8 at each age level

Age		8	9	10	11	12	13	14	15–16
White									
Boys		1.1	1.1	1.5	1.4	2.7	3.2	2.0	2.3
Girls		1.2	1.4	1.4	1.8	1.0	1.6	1.5	1.0
Total	Av.	1.2	1.3	1.4	1.6	1.6	2.2	1.7	1.7
	S.D.	0.76	0.73	0.96	1.09	1.59	1.32	1.34	0.82
Negro									
Boys		1.4	1.2	1.4	1.2	1.4	1.3	1.0	2.2
Girls		1.0	1.3	1.1	1.6	1.8	2.0	1.7	1.4
Total	Av.	1.2	1.3	1.2	1.3	1.6	1.7	1.5	1.8
	S.D.	0.71	0.46	0.68	0.70	0.85	0.86	0.94	0.83
Difference, White-Negro		0.0	0.0	0.2	0.3	0.0	0.5	0.2	−0.1
t		0.00	0.00	0.82	1.10	0.00	1.47	0.40	−0.24

The *t* scores are given as explained for Table III.

TABLE XI

Scores on question 9 at each age level

Age		8	9	10	11	12	13	14	15–16
White									
Boys		0.9	1.1	1.0	1.6	1.7	1.7	1.5	1.7
Girls		1.0	1.3	1.1	1.2	1.2	1.1	1.7	1.3
Total	Av.	0.96	1.2	1.1	1.4	1.3	1.3	1.6	1.5
	S.D.	0.20	0.67	0.64	0.52	0.50	0.98	0.97	0.55
Negro									
Boys		1.0	1.0	1.1	1.5	1.3	1.5	1.7	1.7
Girls		1.0	1.2	1.1	1.2	1.6	1.8	1.4	1.4
Total	Av.	1.0	1.1	1.1	1.3	1.5	1.7	1.5	1.5
	S.D.	0.00	0.58	0.46	0.88	0.86	0.97	0.69	0.88
Difference, White-Negro		−0.04	0.1	0.0	0.1	−0.2	−0.4	0.1	0.0
t		−0.55	0.53	0.00	0.39	−0.66	−1.28	0.28	0.00

The *t* scores are given as explained for Table III.

We may now decide whether or not we are justified in grouping the scores of the two sexes in our subsequent discussions. Table XIII shows the percentage of males at each age level. At most ages, the percentages are not too different for the two racial groups. Especially it should be noted that there is no consistent trend toward a shift in sexual proportion between the races as age increases. In view of this fact, coupled with the only moderate tendency toward sex differences which we have found, we feel justified in combining the scores of the boys and girls for the purpose of making inter-racial comparisons.

b. *Age Trends.* A glance at Figure 1 reveals the fact that there is a slight increase in quantified score with increasing age, with the exception of Questions 5 and 10. These trends are not unlike those found by Deutsche (8, p. 34), although the absolute scores are not comparable because her raw scores were subjected to a somewhat complicated statistical manipulation (8, pp. 30–32).[3] Questions 5 and 10, as we have noted, do not show increasing scores with increasing age. Question 5 required a chemical explanation, while Question 10 involves a knowledge of the physics of sound. The observed decline in scores on these two questions reflects the slightly greater tendency of the older white children to omit answers, while, at the same time, the demonstration for Question 5 failed in two Negro classes, as we have pointed out before, and so only the more retarded

TABLE XII

Scores on question 10 at each age level

AGE	8	9	10	11	12	13	14	15–16
White								
Boys	0.8	0.8	1.5	1.1	1.7	0.8	1.0	0.7
Girls	1.0	1.1	1.0	1.0	1.0	0.7	0.7	0.7
Total Av.	0.83	0.97	1.2	1.1	1.2	0.73	0.80	0.67
Total S.D.	0.35	0.41	0.96	0.62	0.67	0.70	0.78	0.52
Negro								
Boys	1.0	1.0	1.1	0.8	1.2	1.0	1.0	1.0
Girls	1.0	1.0	0.9	1.1	1.1	1.2	1.1	1.0
Total Av.	1.0	1.0	1.0	1.0	1.2	1.1	1.1	1.0
Total S.D.	0.00	0.00	0.29	0.42	0.15	0.42	0.54	0.00
Difference, White-Negro	−0.17	−0.03	0.2	0.1	0.0	−0.37	−0.3	−0.33
t	−1.36	−0.31	0.96	0.63	0.00	*−2.31*	−1.02	*−2.16*

The *t* scores are given as explained for Table III.

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[3] J. I. Lacey (13), in reviewing this work, notes that a letter from Mrs. Deutsche corrects the published procedure. The sigma values are *multiplied*, not *divided* by 2 in step 3. If this correction is made, and if the sigma values are taken as running from 0 to 100 (not 0 to 10), the scores result as given by Deutsche.

older colored children are included. The tendency for the older white children to omit answers will be referred to again in a later section.

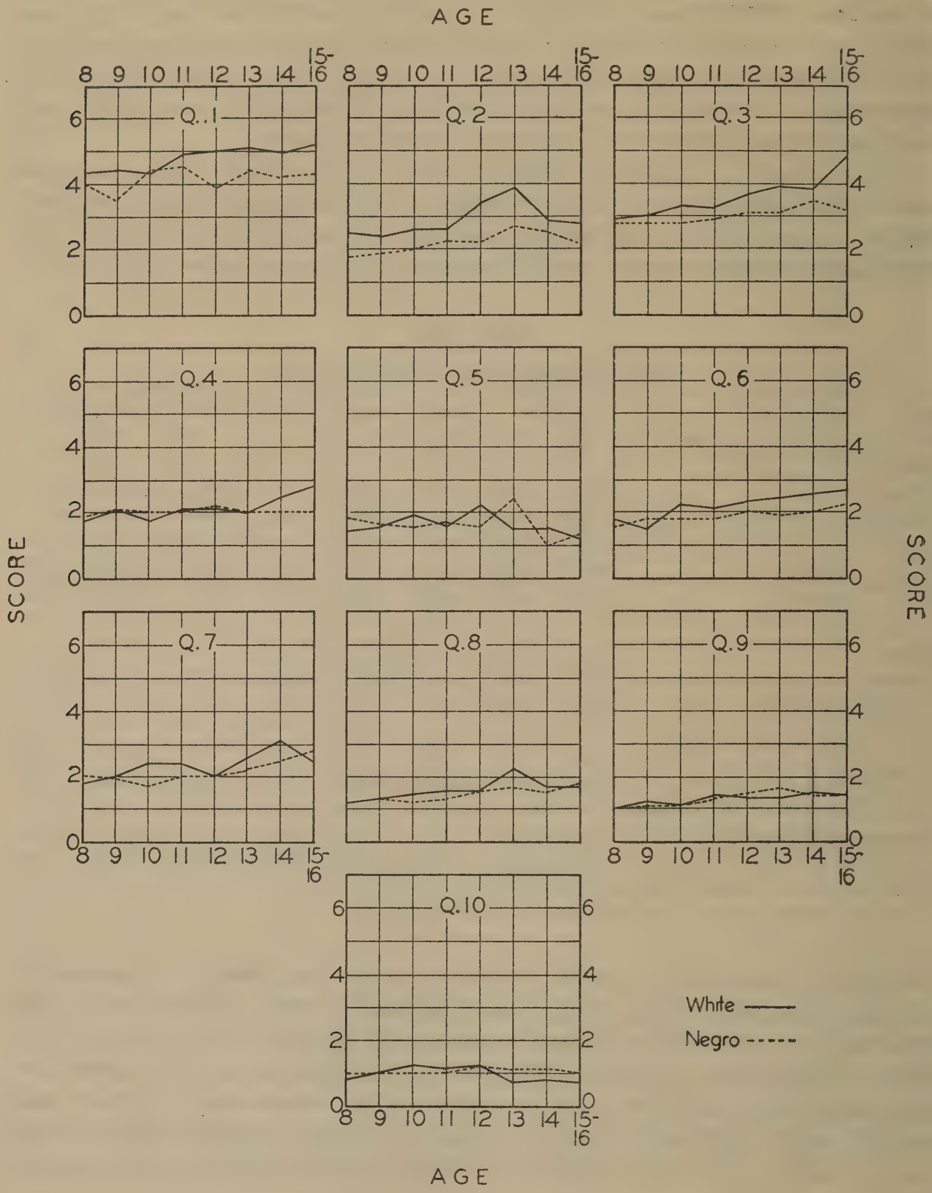

Fig. 1. The Scores Made by the White and Negro Children of Each Age Level on Each Question

The increase in scores from age 8 to age 15–16 is rather small. No doubt this is to be ascribed to the absence of specific instruction during these years

As a result, concepts which *have* been learned are applied throughout. A favorite term was, in its various forms, "gravity," "grapity," or "grapitation." Another

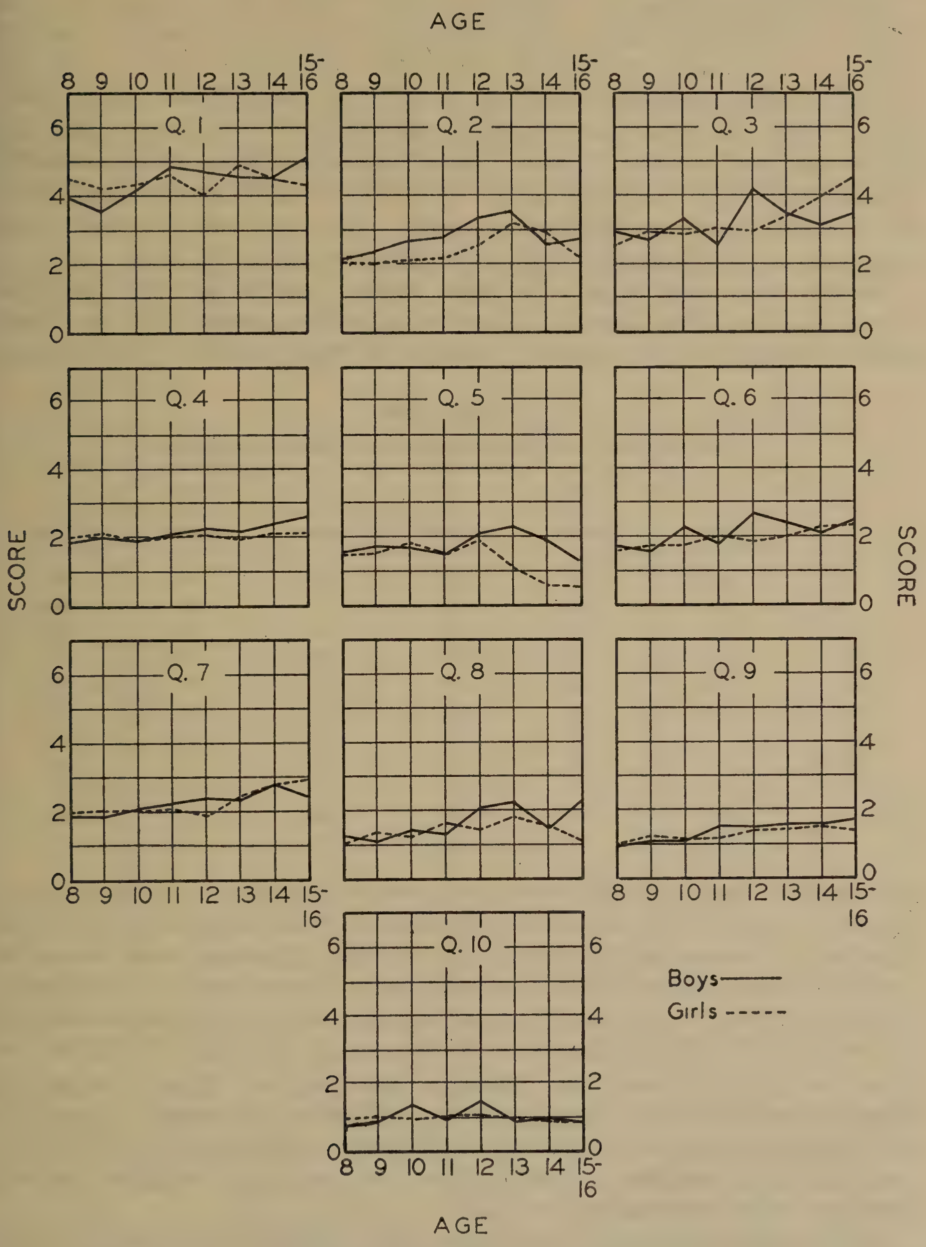

FIG. 2. SCORES MADE BY THE WHITE AND NEGRO BOYS COMBINED AND BY THE WHITE AND NEGRO GIRLS COMBINED

was "pressure," usually spelled "preass." These two terms did yeoman's duty at all age levels. We should logically expect a rise in scores when high-school chemistry and physics are reached, since the children's most obvious lack was information.

c. *Racial Comparisons.* 1. By Age Levels. Tables III through XII and Figure 1 contain the data relevant to the inter-racial comparison of scores. There are 80 possible comparison points—ten question for each of eight age groups. In 50 of these 80 comparisons, or 62%, the white children were superior. Ten of these differences were reliable at the 5% level of significance, and four others were reliable at the 1% level. In all, the white children were significantly superior in 17.5% of the comparisons. In twenty-one of the eighty comparisons, or 26%, the Negro children were superior. Two of these differences were significant at the 5% level, while none was significant at the 1% level.

On only two questions were the white children superior at every age level. These questions were 2 and 3. There is no obvious reason why the Negro children should have been especially retarded on these questions. The explanation probably lies partly within the specific school experiences of the two groups. Questions 1 and 6 show only one exception each to white superiority. As far as Question 1 is concerned, the fairly large absolute differences found are to be ascribed, at least in part, to the absolutely higher average scores. When scores are generally low, the number of omitted answers becomes important, and thus the scale may be diluted somewhat. In the case of Question 6, it will be seen when the qualitative results are considered that there is a different balance of type of answer within the Negro group than within the white group. These four questions specifically mentioned in this paragraph contribute thirty of the fifty points of white superiority, or 60%. They also contribute ten of the fourteen significant white superiorities, or 71.5%.

TABLE XIII

The distribution of the two sexes at the various age levels

AGE	WHITE			NEGRO		
	Males	Females	% Male	Males	Females	% Male
8	16	8	67	5	3	62
9	13	18	42	8	10	44
10	11	14	44	9	15	37
11	8	6	57	12	18	40
12	3	6	33	13	17	43
13	6	9	40	10	17	37
14	4	6	40	3	8	27
15–16	3	3	50	6	7	46
Total.......	64	70	48	66	95	41

The fact that differences in favor of the white children tend to pile up in four questions deserves further comment. These four questions are relatively high-scoring. It will be shown in a later section that the Negro children tend to make fewer omissions on the different questions than do the white children.

For example, while on Question 10 the white children have omitted the answer in 21.6% of the cases, the Negro children have made only 8% omissions. This means that any possible white superiority would have to be exhibited on questions where the percentage of omissions was small.

Because the populations at many of the points of comparison were small, the percentages of overlapping have not been calculated. In order to have a general estimate of the over-all differences, Table XIV was prepared. This shows the percent of the white mean at each comparison point which is represented by the Negro mean, or N/W × 100. For the age level analysis, the Negro means range from 65% of the white mean to 160% of the white mean. The mid-score percentage is 90. We may say that the over-all superiority of the white children was about 10%, although the loose statistical method employed makes this a very unreliable statement. The point of interest is that the percentage obtained in this way is about 10, rather than, say, 50. We may conclude that the two groups, white and Negro, were within the same universe of discourse, and neither is universally or greatly superior to the other, although the Negro group is, on the whole, relatively retarded.

TABLE XIV

The distribution of percentages obtained by the application of the formula negro mean/white mean × 100, where the means were obtained during the question by question age level and grade level analyses

PERCENTAGE	FREQUENCY	
	Age analysis	Grade analysis
160	1	
155	1	
150		
145	1	1
140		
135	1	
130	1	
125		
120	3	2
115		4
110	4	1
105	6	1
100	12	9
95	6	6
90	8	7
85	13	4
80	12	2
75	3	
70	5	1
65	3	
Median	90%	96%

It should also be noted that the tendency for Negro children to do poorl on the same questions on which the white children do not score well is in itself a important fact. Despite minor differences at some points of comparison, th pattern of difficulty of the questions is similar. Perhaps this is more importan

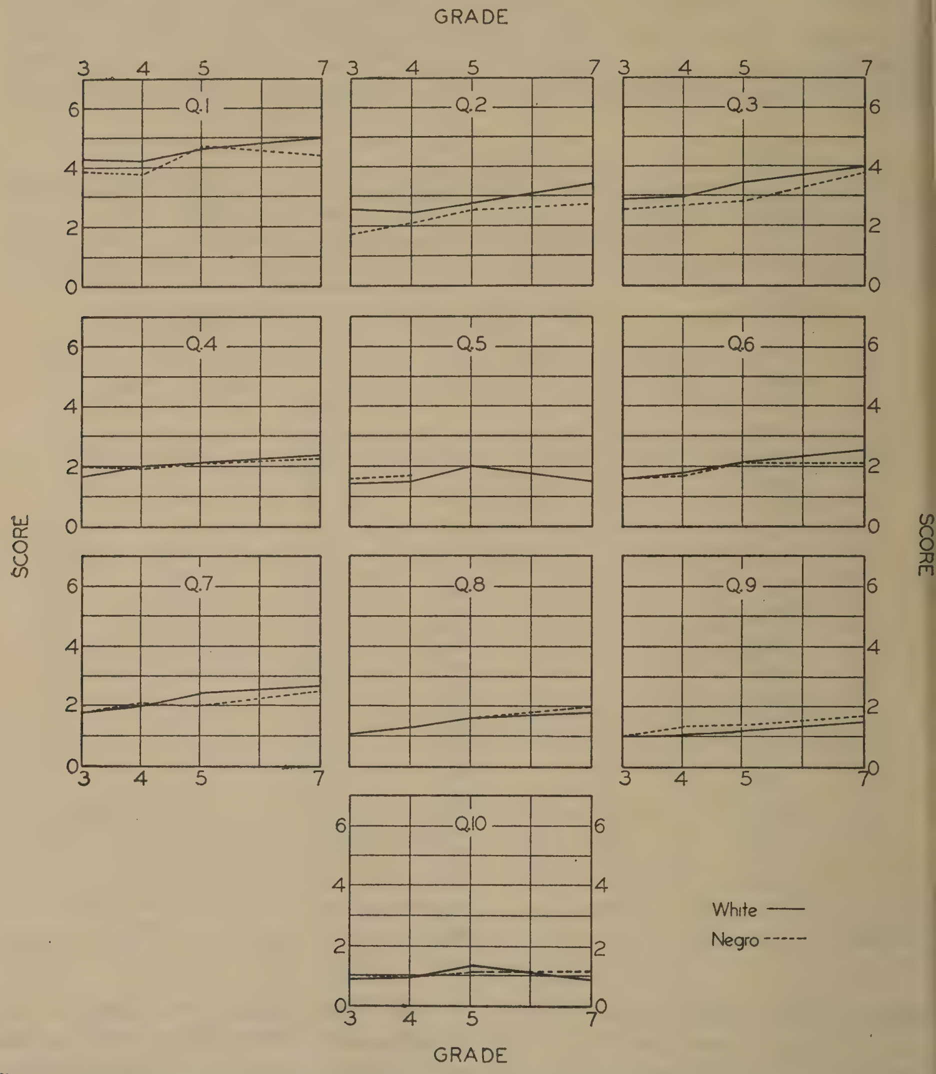

Fig. 3. The Scores Made by the White and Negro Children of Each Grade Level on Each Question

than the question by question, age by age comparisons. Our conclusion that the two groups are within the same universe of discourse is thus strengthened.

2. By Grade. In order to complete the racial comparisons, we have included Figure 3, which shows the question by question standings of the white and Negro

children divided by grade, rather than by age. An analysis similar to that made for the age groups reveals that the white children are superior at 19 out of 38, or 50%, of the comparison points, the Negro children are superior at eleven, or 29%, of the comparison points, and at eight, or 21% of the points, the groups are equal. Table XIV shows the percent of the white means represented by the Negro means, as is also shown for the age group comparisons. It will be seen that the Negroes appear less retarded, and the mid-score percentage is 96. As we have pointed out previously, the Negro grade groups are older than the white groups, and this comparison favors the Negro children. It is very interesting to note, however, that much of the Negro inferiority, as revealed by the age-level analysis, disappears when grade groups are compared.

In order to evaluate the relative contributions of age and grade-level to the scores we have obtained, correlation coefficients were calculated between age and total score, grade and score, and age and grade. Age and grade were successively partialled out, and the coefficients presented in Table XV were obtained.

TABLE XV

Correlations among age, grade, and score for white and negro children

VARIABLES	WHITE N = 134	NEGRO N = 161
Age and grade	.94**	.64**
Age and score	.49**	.32**
Grade and score	.50**	.55**
Age and score, grade partialled out	.065	.039
Grade and score, age partialled out	.21*	.47**

Correlations significant at the 5% level are marked with an asterisk (*), and those significant at the 1% level are marked with a double asterisk (**). All correlations are positive.

A comment on the "score" used in these correlations is necessary. A total score for every child was found by adding together the score for each of nine questions, with Question 5 omitted. This omission was necessary because we have no data for this question from Negro grades 5 and 7. This method of arriving at a total score is merely an approximation, since we have no assurance that like scores on different questions are like in "absolute" value. Since, however, we intend to make no direct inter-racial comparisons with these totals, they are useful in permitting us to calculate correlation coefficients which are at worst rough indices of the relative contributions of age and grade to the total performance of the children.

We had expected, on the basis of Deutsche's results (8), to find that school grade made a moderate contribution to total score. In obtaining her coefficient, children of only one age group, 12 years, were used. We have found so high a correlation between age and grade for the white children that partial correlations between age and score, and between grade and score are negligible, although grade correlates with score a little more highly than does age. Regularity of school attendance and a regularity of policies of promotion from grade to grade are implied by these results.

The Negro children give a different result. For them, age and grade are not highly correlated (.64), and as a result, the partials are more informative. As in the case of the white children, the correlation between age and score is negligible. The partial correlation between grade and score, with age held constant, is .47, which approximates the coefficient of .405 found by Deutsche (8, p. 40). Although many other factors are undoubtedly operating to influence the Negro's scores, school experience is important, while mere age is not. The scholastic retardation of the Negro children is thus important, and an appreciable proportion of their apparent inferiority when age-level comparisons are made must be ascribed to this factor.

Perhaps a further comment on the coefficients for the white children is necessary. The correlation coefficients between score and grade, and between score and age (.50 and .49) are virtually identical, and approximate that found by Deutsche (8, p. 40) between grade and score. We cannot say certainly whether age or grade is more important, because, for these white children, age and grade scores are virtually interchangeable. It may be suspected, however, that the grade is a little more important than mere age, because the partial correlation between grade and score (.21), is somewhat larger than that between age and score (.065), and is, in addition, significant at the 5% level.

3. *Summary*

Although it will be necessary to discuss more fully in a later section the more general aspects of these results, a brief summary of our tentative conclusions may be useful. It is given below:

1. Consistent and appreciable sex differences were not found, although the white boys tended to show some superiority over the white girls, while the Negro boys enjoyed no such advantage.
2. Scores on most questions increased with age, although slightly.
3. Racial comparisons showed that
   a. The Negro children were retarded roughly 10% when age groups were compared, and
   b. Much of this retardation is to be ascribed to the lower grade-level of the Negro children.

VI. QUALITATIVE ANALYSIS

1. *Scoring*

Independently of quantitative scoring, the answers were divided into categories according to the type of explanation given. The construction of a system of classification was the first step in this operation. It was easy to decide on the three major divisions—(A) material, (B) non-material, and (C) omitted and "don't know." After consideration of the difficulties experienced by Deutsche in using Piaget's categories with this type of material (8, p. 51 ff.), it was decided that a somewhat modified set of categories should be devised, which, it was hoped, would reveal more clearly the aspects of the answers in which we were most interested. With this goal in mind, the following schema was constructed. Examples of the type of answer to be subsumed under each heading are given. It should be noted that these examples are not necessarily verbatim reproductions of answers actually found, since they have been rephrased and, in some cases, translated into everyday English.

A. Materialistic
  1. *Mere coincidence in time, no analysis:* ("the jar was put over the candle, and it went out"; "the pebble went to the bottom and the water came up").
  2. *Mechanical effect:* ("the sides of the box held the penny in").
  3. *Due to some physical property of the objects:* ("the water came up because the pebble was heavy").
  4. *Due to physical force:* ("the gravity pulled it down"; "the pressure sucked the water up").
  5. *Logical analysis—forces and objects:* ("the oxygen was all used up, so the candle went out"; "gravity pulled the pebble down and it took up space so the water had to go up").
  6. *Transference of entity from one place to another, mixing, etc.:* ("the colored stuff went all through the water and it changed color").
  7. *Human agency:* ("you blew").
  8. *Construction of the object:* ("the whistle was made that way").
  9. *Concealed agents, tricks:* ("you put the color in when we weren't looking").
  10. *Chemical reactions:* ("it's acid and changed the colored stuff").

B. Non-Materialistic
  1. *Teleological:* ("it makes different sounds because it's meant to").
  2. *Supernatural:* ("God did it").
  3. *Magic:* ("it was magic").
  4. *Moralistic:* ("it had to").
  5. *Animism:* ("the colored stuff separates because it wants to").
  6. *Non-Physical entity:* ("there was something in there that changed the color").

C. Omitted, don't know, illegible.

A few comments concerning the above schema need to be made. It will be noted that A-8, "construction-of-the-object," is classified as materialistic, whereas Deutsche, under the heading of "artificialistic causality," classifies this type of answer as non-materialistic (8, p. 65). We have preferred to reserve the "non-materialistic" classification for those explanations which involve agencies or forces outside the observable course of events. Saying that "it was manufactured that way" does not imply supernatural or mystical intervention, but refers to a perfectly reasonable event in the material world. Some confusion arises when we attempt to distinguish this category from the "teleological." Fortunately, the percentage of answers which could lay claim to being teleological was very small, and any doubtful case was placed in the B-1, or "teleological," category. There is also some doubt as to whether "magic" is non-materialistic. The children using this term may have meant merely that it was a "trick." This difficulty of classification is, of course, one of the drawbacks of the group testing technique. In practice, a bald statement that "it was magic" was classed as non-material.

It will be noted that we have not classified our answers in terms of Deutsche's "materialistic sequence," despite the fact that we shall have many occasions for comparing our results with hers. As explained in her monograph, this sequence of five steps was designed to classify the materialistic answers in terms of ". . . the completeness of the mechanical explanation as well as recognition of the principles involved" (8, p. 73). An examination of the five categories reveals that they form a scale which is comparable to that used in finding the quantified scores (8, p. 30). Since the "materialistic sequence" of Deutsche appears largely to duplicate the quantitative scoring, we have not considered it worthwhile to include such an analysis here.

The actual distribution of the answers among the various categories was done, one complete question at a time, by the senior author. This sorting was then checked by one of the judges who had participated earlier in the quantitative scoring.[4] In case of disagreement, a conference served to remove the difficulty. Complete agreement was reached under these circumstances. There were borderline answers, of course, which could be placed in more than one category. The bulk of the answers to any given question, however, tended to fall into a relatively few general types. This fact was noted also by Deutsche (8), and contributed to the consistency of our sortings.

2. *Results*

a. *Sex Differences.* Table XVI shows the percentage of answers of each type given by the boys and girls of the various ages. The white and Negro percentages have been given separately. An examination of the totals for each sex within each racial group reveals a very close correspondence in the percentage distribution of type of answer. Differences are nowhere more than a few percent. Since, however, these totals are derived from populations unequally divided between the sexes at the different age-levels, we must examine the age groups separately.

When the number of cases is considered, most of the age groups among the white children do not show sex differences which appear significant. At age 9, however, there is a fair number of cases, and a fairly sizable difference. It will be noted that the girls gave 15% more A-3 responses than did the boys, and, further, this difference is almost balanced by the opposite difference in percentage of omissions. The girls have preferred to mention some properties of the objects used as being causes of the observed phenomena, rather than to omit the answers. This reluctance of the girls to omit answers declines with age, however. The ability to give A-5, "logical," answers does not seem to be particularly

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[4] Margaret Hubbard Jones.

TABLE XVI

The percentage distribution of types of answer divided by race and sex

TYPE	WHITE		NEGRO	
	Boys	Girls	Boys	Girls
A-1	12.7	15.9	20.2	17.2
-2	28.3	30.9	27.3	25.6
-3	24.4	28.6	27.8	29.6
-4	3.8	1.7	3.2	4.0
-5	8.4	5.7	3.8	5.8
-6	0.8	1.1	1.1	1.5
-7	1.1	0.6	0.9	1.8
-8	5.0	3.4	3.8	5.7
-9	3.1	4.4	4.6	4.2
-10	1.6	0.4	0.6	0.0
B-1	0.0	0.0	0.0	0.1
-2	0.0	0.0	0.0	0.1
-3	0.0	0.1	0.0	0.2
-4	0.0	0.0	0.0	0.1
-5	0.0	0.9	0.3	0.6
-6	0.2	0.1	0.2	0.0
C	10.8	6.1	6.3	3.4
Total............	100.2	99.9	100.1	99.9

TABLE XVII

The percentage distribution of types of answer according to question: white children

TYPE	QUESTION									
	1	2	3	4	5	6	7	8	9	10
A-1	6.0	8.2	10.4	3.0	11.9	8.2	55.2	20.9	3.0	15.7
-2	19.4	68.7	8.2	44.8	3.7	53.7	4.5	3.0	65.7	24.6
-3	61.2	11.9	42.5	35.8	18.7	11.2	17.9	47.0	16.4	3.7
-4	1.5	6.0	0.7	3.7	0.0	4.5	2.2	0.0	6.7	1.5
-5	5.2	1.5	31.4	6.0	0.0	3.7	12.7	2.2	0.7	6.0
-6	0.7	0.0	0.7	0.0	0.0	7.5	0.0	0.0	0.0	0.7
-7	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.7	6.7
-8	0.0	0.7	3.0	3.0	16.4	4.5	0.7	0.7	0.0	12.7
-9	0.7	1.5	0.7	1.5	23.9	1.5	0.0	4.5	0.0	3.7
-10	4.5	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0
B-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5	0.0	0.0	0.0	0.0	0.7	0.0	0.0	2.2	0.0	1.5
-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
C	0.7	1.5	2.2	2.2	19.4	3.7	6.7	18.7	6.7	21.6
Total..................	99.9	100.0	99.8	100.0	99.9	100.0	99.9	99.9	99.9	99.9

greater in either sex, and although the boys give a higher percentage of these answers at 13, this relationship is reversed at 15–16.

The percentages of the Negro children's answers do not show any consistent sex differences. There is a slightly greater tendency for the males, as in the case of the white children, to omit answers, but this is clearly apparent only at ages 11 and 13. There are so few cases at age 8 that the 8% omissions shown for the boys is not to be relied upon.

In general, sex differences, as in the case of the quantitative scores, do not seem to be very important. This conclusion is consistent with Deutsche's results, since she found but little difference (8, p. 69). For purposes of further comparison, therefore, we have combined the scores of the two sexes.

TABLE XVIII

The percentage distribution of types of answer according to question: negro children

TYPE	QUESTION									
	1	2	3	4	5	6	7	8	9	10
A-1	12.3	15.3	14.7	4.3	40.3	28.2	22.1	29.5	3.7	30.1
-2	11.7	52.8	9.8	41.7	1.2	35.6	5.5	4.9	65.0	20.3
-3	56.4	9.8	46.6	29.4	15.8	8.0	46.6	48.5	11.6	8.0
-4	0.0	8.6	3.1	6.1	1.2	6.1	0.0	1.8	7.4	0.6
-5	9.2	0.0	18.4	4.9	0.0	1.2	9.2	0.6	3.1	0.0
-6	0.0	0.0	0.6	0.0	0.0	6.7	0.0	0.0	0.6	4.9
-7	0.0	0.0	0.0	0.0	1.2	0.6	1.8	0.0	1.8	9.2
-8	0.6	1.2	3.1	8.6	3.7	8.0	6.1	0.6	0.6	16.0
-9	6.7	6.1	1.8	3.1	24.4	1.2	1.2	4.9	3.1	0.6
-10	1.2	0.0	0.0	0.0	1.2	0.0	0.0	0.6	0.0	0.0
B-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
-2	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
-5	0.6	0.0	0.0	0.0	3.7	0.0	0.0	1.2	0.6	0.0
-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
C	1.2	6.1	1.2	1.8	7.3	4.3	7.4	6.7	2.5	8.0
Total................	99.9	99.9	99.9	99.9	100.0	99.9	99.9	99.9	100.0	100.1

b. *Influence of Question on Type of Answer.* Tables XVII and XVIII show the percentages of answers given by the white and by the Negro children, divided according to question. Since, in many cases, the white and Negro percentages are dissimilar, it will be necessary to consider these racial differences here. Deutsche's results (8), obtained by a similar technique, provide a convenient "bench mark" for our considerations.

One caution must be exercised in interpreting the racial comparisons. The average age of the white children was 10.5 years, and that of the Negro children was 11.4 years. Therefore, if we subsequently can show age trends in certain types of answer, and we shall, *equal* percentages for the two groups would imply

Negro retardation. To anticipate for the sake of pointing to an example of such a situation, we may say that a decline in A-1, "mere coincidence" answers is the most obvious and important age trend found. This point must be kept in mind during the reading of the following paragraphs, and will be referred to again when we summarize the qualitative racial comparisons.

Question 1, candle-in-jar, has evoked a large percentage of A-3 answers. That is, the children tended to explain the candle's going out by reference to some physical characteristic of the situation. There are relatively few A-5, "logical," answers, although this question was quantitatively high-scoring. Such a comment as "It's air-tight" would be classified A-3, but might get a fair quantitative score. There appear to be no obtrusive racial differences, except for a possibly greater tendency for the Negro children to think that they were being tricked.

In general, our results are in agreement with those of Deutsche (8, p. 82), in that this question was relatively easy, and also in that only one (0.6%) non-material answer appeared. The percentage of omissions was also small, and this is testimony for the relative confidence with which the children approached this question. It may also be suspected that the fact that this question was given first had some influence, since the children were fresh, the situation novel, and boredom absent.

Question 2, penny-in-box, also yielded results quite comparable to those of Deutsche (8, pp. 82–83). A-2, "mechanical effect," answers formed the bulk of the responses given by both races. Since "speed" was considered to be a mechanical term in this context, the answer "It was going so fast" helped swell this category. We find few racial differences. Again the Negro children had a slightly greater tendency to report "trickery" than did the white. No child, white or Negro, gave a non-material answer.

Question 3, level-of-water, introduces some racial differences. Our white group has given responses notably high in percentage of A-5, "logical analysis," answers. It will be noted that the Negro children fall about 13% below the white children in this category. The most frequent type of answer for both racial groups was, however, the A-3, "physical property." Statements that the pebble was heavy, and so pushed the water up, were of frequent occurrence. About 10% of both groups were content with A-1 responses, such as "You dropped it, and the water came up." Only one response, by a Negro child, was non-material. Although retarded somewhat in the development of the logical explanation of this phenomenon, the Negro children did not, at least, appeal to agencies outside the normal course of events.

Question 4, block-dropping, evoked from both racial groups primarily A-2, "mechanical effect" and A-3, "physical property," answers. Statements that the block was heavy or hard, or that the sound came from the block and table's hitting together were very frequent. Despite the fact that only a few (5 or 6%) of the children of either race could give logical explanations, no non-material responses were found. No doubt all of the children could have predicted that noise would follow the dropping of the block, but the mere knowledge of sequence is not adequate for a complete explanation. In this statement we agree with Deutsche (8, p. 86).

Question 5, changing-color-of-liquids, has, it will be remembered, an inadequate sampling of the higher age ranges of the Negro children. This inadequacy makes it impossible to evaluate the significance of the very high percentage of A-1, "mere coincidence," answers given by the Negro children. It will be shown in a later section that the percentage of A-1 answers given by the Negro children drops very sharply with age, and we are therefore not inclined to attribute undue significance to this obtained result. The large percentage of A-1 answers given by the Negro children is balanced somewhat by the large (19%) number of omissions made by the white children. Here the pressure toward giving an answer of some sort has affected the Negro children more strongly than the white. Rather than omit the answer, they have turned in a mere statement of what happened. This same tendency will be noted in later questions, particularly 8 and 10.

The most frequent category for the white children was A-9, "trickery." This is not surprising, since changing the color of a liquid is a favorite amateur magician's trick. No one of either race actually referred to the color change as "magic," however. The white children gave answers of the A-8 category, "made that way," to the extent of 16%. The Negro children also gave a large number of the A-9, "trickery," responses, but tended to give answers classifiable as A-3, "physical property," rather than the A-8 answers favored by the white children. Perhaps this difference between A-8 and A-3 answers is terminological rather than meaningful. This, again, cannot be decided by a group investigation.

Very few answers from either group referred to chemical reactions (A-10). This was in sharp contrast to the results obtained by Deutsche. She reports a ". . . surprisingly large . . ." (8, p. 85) percentage of answers referring to acids and other chemicals. We cannot be certain, of course, as to the exact percentage she obtained, but it was probably larger than ours. The differences in school background can readily account for the dissimilarity of Deutsche's and our results.

We have obtained from this question a few "animistic," B-5, answers. As Keen (11) points out, however, we cannot be sure that a statement that a color is "eaten up" means that something alive is considered to be at large in the solution. Even professional chemists and physicists speak of "attractions" between atoms, of certain substances having an "affinity" for water, and of acids "eating away" metals. In any case, we agree with Deutsche that the preponderance of material answers is important when elicited by a question which might be expected to evoke magical answers.

Question 6, bulb-on-tube, resulted primarily in unanalytical answers, with the A-2, "mechanical effects," category predominating in both racial groups. The type of answer frequently found was of the nature, ". . . the bulb sucked it up," or ". . . the bulb sprang out and sucked it up." In most cases, the reference was to the action of the bulb, and these answers have been classified as A-2 rather than A-4, "physical force." This is a debatable point, and it may be that the A-4 category would be preferable. A change in categorization would not affect the racial comparison, however, since it would affect both groups about equally. Those answers which referred to "suction," or to the frequently mentioned "preass" (pressure) were included in category A-4.

The Negro children gave very many more of the A-1, "mere coincidence," answers than did the white children. There were many statements that ". . . you squeezed it and let go and the water came up." Very few children of either group were able to give "logical," A-5, answers, but on the other hand, there were no non-material responses.

Question 7, teeter-totters, yielded a most clear-cut racial difference. The white and Negro children differed sharply in the relative frequency of A-1 and A-3 responses. More than half (55%) of the white children's answers were of the A-1, "mere coincidence," variety, while nearly half of the Negro children's answers were classifiable as A-3, "physical property," responses. The weight of the blocks was appealed to very often by the Negro children. The meaning of this racial difference is not obvious, and any inferiority of the white children implied by this result is not reflected in the quantitative scores.

"Logical," A-5, answers are not numerous, but do comprise about 10% of the total. We do not know whether or not this corresponds to Deutsche's "very small" number (8, p. 86). There were no non-material answers from either group.

Question 8, mixed-liquids, evoked answers differing very little in category between the two racial groups. Most responses referred either to the physical properties of the liquids, e.g., weight, or were mere statements of the observable events. Thus, categories A-3 and A-1 are large. A fairly large number of white children (almost 19%) omitted the answer to this question. Here again the tendency of the Negro children to write something down, even if merely a statement of what happened, rather than omit the answer is seen in the fact that the Negroes' A-1 responses almost exactly balance the difference between the white and Negro children's percentage of omissions.

A few non-material answers appeared, including five B-5, or "animistic," ones. Since these were of the nature of statements that the liquids didn't "like each other," the remarks made in the discussion of Question 5 apply here. Deutsche reports a slightly higher proportion of "internal non-materialistic" answers (which would contain animistic responses) than we have found. In our results, it is important to note that a problem so difficult as to evoke an omission from almost one white child in every five has still resulted in so few non-materialistic explanations.

Question 9, paper-on-jar, gave rise to answers two-thirds of which were classifiable as A-2, "mechanical effect" responses. The popular explanation with both racial groups was that the paper stuck to the jar in one way or another. Only a relatively few children, about 7%, appealed to "physical force," such as suction. An even smaller number were able to bring any logical analysis to bear on the problem. Here the usual tendency for the Negro children to leave fewer omitted answers is present, but this is the only apparent racial difference. Only one non-material answer was given, by a Negro child.

Our subjects were perhaps somewhat retarded on the question, according to the results of other experimenters (Huang, 10; Keen, 11; Deutsche, 8). This retardation is shared by both racial groups, and as in the case of Question 5 may well be ascribed to differences in scholastic background.

Question 10, musical-instrument, provides another illustration of the greater tendency of the white children to omit answers. Almost 22% of the white children have omitted the answer to this question, while only 8% of the Negro children have made this omission. As in the case of Question 8, the difference in percentage of omissions is balanced by the reversed difference in percentage of A-1, "mere coincidence," answers.

About 15% of the children were content to affirm that the whistle was "made that way" (A-8). A few merely stated that "you blew" (A-7). About one child in five gave a "mechanical," A-2 answer. In this instance, the borderline between A-1 and A-2 was difficult to determine, and answers appealing to the position of the plunger as being important in some specific way were classified as A-2. A mere statement that the slide moved up and down and the notes changed was classified as A-1.

No Negro child gave a "logical," A-5, answer, although 6% of the white children were able to do so. It is possible that some specific training may have entered into this difference, since the white children probably had a greater opportunity to play wind instruments. A very few non-material answers were found.

In sum, we may say that there is no doubt that the nature of the question asked determines in appreciable measure the type of answer given, just as the behavior of any organism depends partly upon the situation in which the organism finds itself. The variation from question to question is very large, and exceeds 60% in one instance. This observation is in complete agreement with Deutsche's conclusions.

Since the general racial comparisons deserve more than summary treatment, they will be discussed more fully later in this paper.

c. *Age Trends.* Tables XIX and XX give the percentages of the various types of answer found at each age-level. In order to make the trends more readily perceptible, Figures 4 and 5 have been prepared. Figure 4 shows the percentage of the three major categories, "material," "non-material," and "omitted and don't know," found at the different age levels. Figure 5 shows the most important categories under the "material" heading. These figures permit direct racial comparisons.

A glance at Figure 4 shows how predominantly material were the responses at every age. The slightly greater percentage of material answers given by the Negro children at all but one age-level is to be explained by their smaller number of omissions. It will be noted that the percentage of non-material answers is very small for both groups. The percentage of material answers runs about 10% higher than that found by Deutsche (8, p. 67). No doubt a difference of

TABLE XIX

The percentage distribution of types of answer divided according to age: white children

TYPE	AGE							
	8	9	10	11	12	13	14	15–16
A-1	18.3	17.1	16.8	15.0	7.8	8.7	4.0	13.3
-2	25.8	24.8	28.8	33.5	35.6	31.3	38.0	35.0
-3	35.8	34.5	24.0	21.4	21.1	19.3	20.0	10.0
-4	1.2	0.6	4.4	7.1	1.1	2.7	4.0	1.7
-5	1.2	3.5	6.8	7.1	13.3	12.7	10.0	18.3
-6	0.4	0.6	0.0	1.4	2.2	2.0	2.0	3.3
-7	2.1	1.0	1.2	0.7	0.0	0.0	0.0	0.0
-8	4.2	4.2	3.2	2.9	7.8	6.0	2.0	5.0
-9	2.5	4.2	4.8	4.3	1.1	4.7	5.0	1.7
-10	0.0	0.3	0.8	0.7	3.3	1.3	2.0	1.7
B-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5	0.8	0.3	0.4	0.0	0.0	0.7	1.0	0.0
-6	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0
C	7.1	8.4	8.8	5.7	6.7	10.0	12.0	10.0
Total.....	99.9	99.8	100.0	99.8	100.0	100.1	100.0	100.0

TABLE XX

The percentage distribution of types of answer divided according to age: negro children

TYPE	AGE							
	8	9	10	11	12	13	14	15–16
A-1	45.0	25.0	22.3	22.2	16.4	8.9	8.9	6.7
-2	17.5	24.4	25.3	28.5	23.6	29.8	25.7	31.7
-3	20.0	26.1	29.2	28.5	30.7	31.4	27.7	28.3
-4	1.3	0.0	0.0	3.5	7.9	6.5	3.0	5.0
-5	2.5	1.7	2.4	2.1	7.5	6.0	13.9	7.5
-6	0.0	0.6	0.0	1.0	0.4	3.2	4.0	3.3
-7	3.8	3.3	1.7	0.7	0.7	0.4	2.0	1.7
-8	3.8	4.4	6.0	4.9	4.6	4.8	4.0	5.8
-9	1.3	7.8	4.7	3.1	3.6	4.0	2.0	8.3
-10	0.0	0.0	0.4	0.0	0.7	0.0	1.0	0.0
B-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
-3	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
-5	0.0	1.7	1.7	0.0	0.0	0.0	0.0	0.0
-6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
C	5.0	5.0	5.2	5.6	3.6	4.8	6.9	0.0
Total.....	100.2	100.0	100.0	100.1	100.1	99.8	100.1	99.9

this magnitude could arise from slight discrepancies in the placement of certain answers, and we are more inclined to accept this explanation than to assume that our samples were more "materially minded."

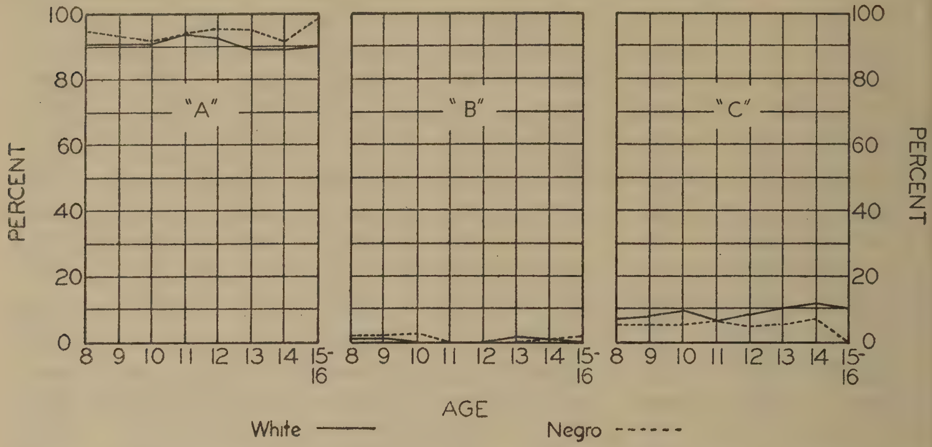

FIG. 4. THE PERCENTAGE OF EACH OF THE THREE MAJOR QUALITATIVE CATEGORIES OF ANSWER AT EACH AGE LEVEL

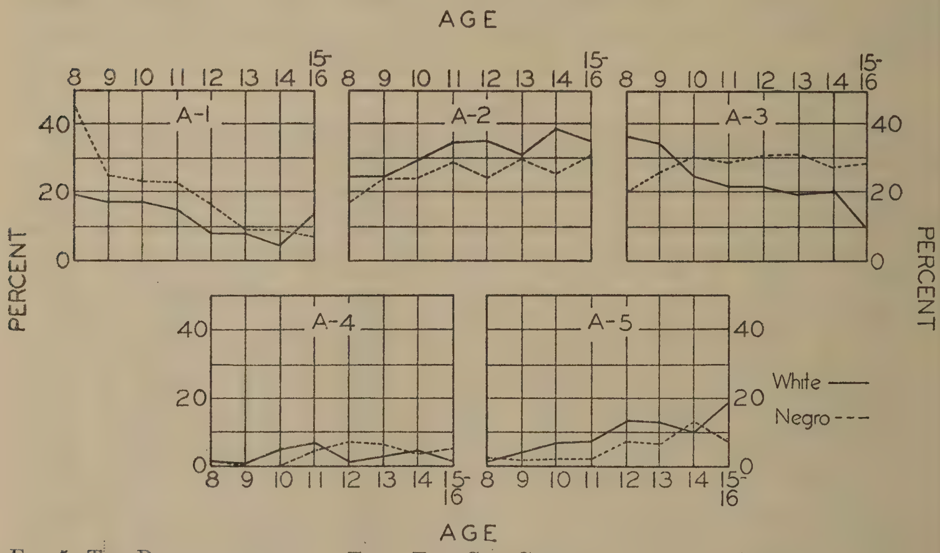

FIG. 5. THE PERCENTAGE OF THE FIRST FIVE SUB-CATEGORIES OF THE MATERIAL CATEGORY AT EACH AGE LEVEL

Most significant from our point of view is the complete lack of any tendency for the Negro children to give non-material answers in larger number than the white children. This is a most important observation, and will be referred to again when we summarize the qualitative racial differences.

When we proceed to the consideration of the sub-categories within the material classification, we find racial differences of appreciable magnitude. The individual categories will be discussed below.

The percentage of A-1, "mere coincidence," responses declines with age for both racial groups. This result corroborates Deutsche's finding that her "No.5," or "phenomenalistic," category declined in magnitude with the age of her subjects. In fact, the curve obtained from our Negro subjects is very similar to the one she gives (8, p. 75). We have found a striking racial difference, however, for our white children's responses in the A-1 category are fewer at the earlier ages. It would appear that the Negro children are retarded roughly one year as compared to the white children. The sole exception to this relationship is at the 15–16 year level, where there is a sudden rise in the curve for the white children's A-1 answers. This rise is accompanied by an increase, not a decrease, in A-5, "logical," answers. For this reason, we are inclined to regard the increased percentage of A-1 responses as probably "accidental," i.e., artifactual as far as our problem is concerned. There is not sufficient evidence to suggest that a secondary shift back to phenomenalism occurs, and Deutsche's results clearly do not show such a trend (8, p. 75).

The trend of A-2, "mechanical effect," answers is the same for both groups. There is a slight but appreciable tendency for the white children to give a greater percentage of these A-2 answers. It seems reasonable to conclude that this tendency confirms the implications of the A-1 category differences. That is, a more advanced type of answer is being given by the white children.

The A-3, "physical property," classification shows a clear-cut reversal of trend when the two racial groups are compared. The white children's answers are less likely to be classified as A-3 the older the child, while the Negroes' answers increase in percentage of A-3 responses with increasing age. Since an answer categorized as A-3 appealed, for the explanation of the given phenomenon, to an unanalyzed and unelaborated physical property, such as weight, of some object or objects in the situation, we are inclined toward viewing a rise in this category as evidence of comparative retardation. The fact that this category shows a magnitude at age 8 for the white children which is approached at age 10 by the Negroes, suggests that the white children have already passed beyond a period of rising frequency of A-3 answers. This is entirely plausible and not in violation of the results of other investigators.

Although A-4, "physical force," answers were not numerous, they have some theoretical importance, and deserve brief mention. It will be seen that both curves, white and Negro, rise at first, and decline after reaching a maximum at an intermediate age. This maximum is reached one year later by the Negro children and, taken together with our other results, may be interpreted as corroborating our previous comments on the retardation of the Negroes.

A-5, "logical" answers are of great importance for our purposes. Both the white and Negro children tend to give a larger percentage of A-5 responses as they grow older. This is entirely consistent with Deutsche's results (8, p. 75), even to the percentages found. Except at one age-level, 14, the white curve lies somewhat above that for the Negroes. There is therefore associated with the other trends we have discussed above, a slightly greater tendency for the white children to give "logical" answers.

Categories A-6, A-7, A-8, A-9, and A-10 do not, individually, contain any large percentage of the answers. Because of this, trends and differences amount to only a few percent, and no great significance can be attached to them.

To summarize our discussion of age trends, we may say that with increasing age there is a definite decline in the number of answers which give mere contiguity of events as explanations, and in increase in logical responses and in answers attributing the phenomena to mechanical effects. At the same time, the white children give progressively fewer explanations appealing to the physical properties of objects in the situation, and the Negro children show an increase in this category with increasing age. Answers explaining the phenomena in terms of physical forces rise in number until age 11 or 12, and then decline, probably in favor of logical answers. The general impression was gained that the Negro children tended to lag somewhat behind the white children in these age trends. But most importantly, there was no appreciable tendency for children of any age or either race to give non-material answers.

d. *Racial Differences.* Although we have referred to racial differences quite fully in the several previous sections, there are more general comments concerning the qualitative differences which need to be made. We have shown that the type of answer given to the various questions does not, by and large, differ between the two groups. As we have pointed out before, however, the Negro sample is about one year older, on the average, than the white sample. Since certain types of answer tend to diminish in frequency with age, and certain other types increase, equality in this instance means Negro retardation. The exact extent of this lag is not easy to estimate. Since our two samples, white and Negro, are for most questions substantially equal in qualitative performance, we may hazard the suggestion that the Negroes are retarded roughly one year. This result checks reasonably well with Bruce's work on the development of "animism" (5). Our suggestion receives support from our examination of the age trends, which showed quite clearly a tendency for the Negro children to lag in development, especially in the elimination of phenomenalistic answers.

In order to aid us in evaluating this comparative retardation shown by our Negro sample, the percentage division of answers among the various categories found for the different grades is shown in Figure 6 and Table XXI. We have given in Figure 6 only the five sub-categories of the material classification which we have had occasion to discuss in the section on age differences. Analyzed in this way, the racial differences which we found when the scores were analyzed according to age are not so clearly apparent. Although the Negroes in grade 3 show a substantially greater number of A-1 answers than do the whites, this difference is virtually eliminated by grade 4, and an actual inversion occurs at grade 5. Not only did the white children show more A-1 responses in grade 7, but a glance at Table XXI shows that they also made very many more omissions, and so the Negroes are not actually retarded at these upper grade levels.

The percentages of A-2 answers are not at any point strikingly different, and we need not delay over them. It will be remembered that the age analysis showed that while the white children gave fewer A-3 answers with advancing age, the Negro children gave more. This trend is not so striking here, although it is still present.

The trend of A-4 answers is not particularly different for the two races. The percentages of A-5, "logical," responses do show some differences. While the two curves, white and Negro, begin virtually at the same level, the Negro curve actually declines between grades 4 and 5, and then turns sharply upward to grade 7. The white curve, on the other hand, rises gradually to the seventh grade level. At the extreme grades, 3 and 7, the two curves are almost identical in level, but the Negroes fall below the whites particularly at grade 5. At the intermediate levels, the absolute percentages are small, and so the absolute differences are not strikingly large. It is not reasonable to maintain that these differences are due entirely to chance, but at the same time it cannot be argued that they are significant. A possible explanation is that the older, more retarded Negro children have left school at about 15, and therefore grades 4 and 5 contain a scholastically less successful group of older children.

TABLE XXI

The percentage distribution of types of answer according to grade: white and negro children

TYPE	GRADE							
	3		4		5		7	
	W	N	W	N	W	N	W	N
A-1	19.1	34.9	16.6	23.4	15.2	9.5	7.6	4.7
-2	23.9	19.2	27.2	24.2	32.2	29.3	33.9	33.0
-3	35.5	25.6	29.0	23.4	26.4	36.8	17.4	30.6
-4	0.9	0.3	1.6	2.1	5.5	9.8	2.9	2.8
-5	1.2	1.6	3.4	3.3	8.4	2.2	13.7	13.3
-6	0.6	0.5	0.3	0.5	0.6	1.6	2.1	3.1
-4	2.1	3.0	0.3	0.9	1.3	1.4	0.0	0.6
-8	3.3	4.3	5.6	4.0	1.9	4.3	5.5	7.2
-9	2.1	3.8	4.7	7.9	5.2	2.2	3.4	3.1
-10	0.3	0.0	0.0	0.5	1.6	0.0	1.8	0.6
B-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
-2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
-3	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.0
-4	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
-5	0.6	0.5	0.6	1.2	0.0	0.0	0.5	0.0
-6	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.3
C	10.0	6.2	10.3	8.4	1.6	2.2	10.8	0.6
Total.....	99.9	99.9	99.9	100.0	99.9	100.1	99.9	100.2

Probably more important than the trends within the materialistic category is the relative number of non-material, i.e., animistic, supernatural, superstitious, magical, and moralistic answers. Neither group gave such answers in appreciable number (*cf.* Figure 3). The Negro children have not made more frequent appeals to agents outside the physical world. As far as our experiment is concerned, the Negroes have not shown themselves to be more superstitious or supernaturally inclined than the white children. Admittedly, our technique was not designed to force a large number of non-material answers. Nevertheless, any all-pervasive supernaturalism should have appeared, if it existed. The fact that no such tendency was apparent indicates, at the least, that the Negro is not necessarily superstitious or supernatural in his dealings with reality.

The conclusion reached in the paragraph above should be considered in the light of McAndrew's clear demonstration that the "religiosity" of the mother induces supernaturalism in the child (16). In her studies, however, questions were asked for which the religious parent had undoubtedly supplied ready-made supernatural answers. An example is, "Why does it rain?" The answer that "God sends it," is one which the religiously inclined parent might well supply. Of course, a trained meteorologist, even if religious, would give quite a different answer, because he has the relevant information. It would be a mistake to assume that the supernatural answers are any less the products of past experience than are the objective ones. When the children in our investigation were presented with novel situations they did not resort to supernaturalism, and we assume, therefore, that they had not been trained to do so.

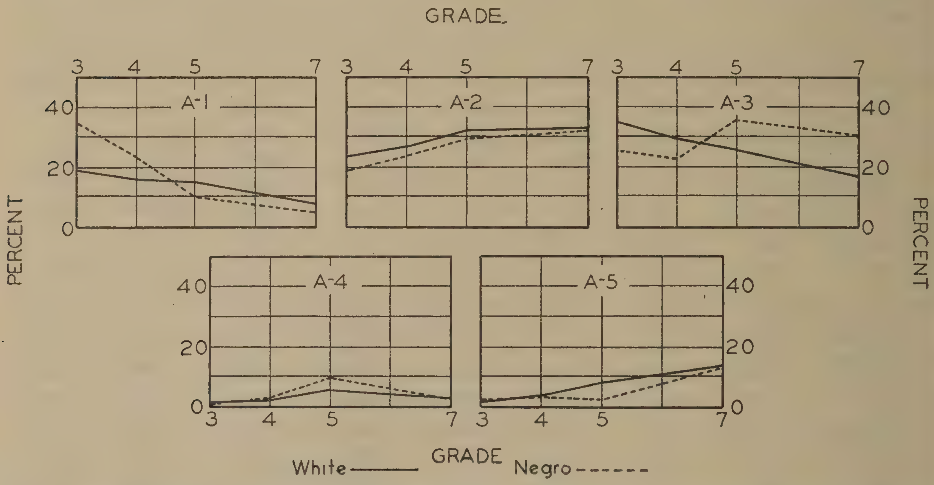

Fig. 6. The Percentage of the First Five Sub-Categories of the Material Category at Each Grade Level

It is very easy to overlook the similarities in the behavior of our groups because of our preoccupation with differences. It is probably not incorrect to say that the white and Negro children were attacking the problems we have presented them in much the same ways. Even though answers might be very inadequate, from the scientific point of view, they were, quite without exception, related to the situation at hand. Completely irrelevant answers, appealing to unrelated events at the other end of the table, for example, were not given. Compared to the essential similarity, the qualitative differences we have found are not unduly impressive.

VII. DISCUSSION OF RACIAL DIFFERENCES

We have shown that, both quantitatively and qualitatively, the explanations of simple physical phenomena given by our Southern Negro sample are somewhat inferior to those given by a similarly selected sample of Southern white children. The quantitative inferiority is by no means invariable, and, when the children are compared on the basis of chronological age, may be estimated roughly as 10%. The qualitative inferiority is expressed by a comparative lag in various age trends. It would be most incautious to argue from our results that these differences are in any sense innate. In order to decide upon their meaning, it is necessary to consider first, the limitations placed upon our conclusions by our methods, and, second, the factors acting to depress the scores of one racial group as compared to the other.

1. *Methodological Limitations*

We have mentioned elsewhere the points given below. In order to have them before us as we draw our final conclusions, they are assembled here.

First, this was a group test. There is no need to emphasize the fact that this is a serious limitation, in that it makes interpretations of certain answers very difficult. On the other hand, the group testing technique has permitted us to gather many more cases than would otherwise have been possible, with a subsequent improvement in the adequacy of our samples.

Second, our conclusions must be limited to the type of problem we have presented. We have dealt entirely with concrete situations, and not with verbal problems. This has the advantage of avoiding some part of the language handicap which may possibly have been affecting the Negroes. This factor will be discussed more fully below.

Third, our results are true only for an average small Southern city (25,000) sample. We have endeavored to obtain a representative sample of both the white and Negro children of the community. Our conclusions cannot, however, be applied directly to rural or large-city children, or can they be applied outside of the region in which we have worked.

Fourth, some error may have arisen through the inaccuracy of the ages obtained from the children. We have faced this issue previously, and have given our reasons for believing that it is not unduly serious. Since we have treated our results on a grade as well as on an age basis, a measure of control of this factor has been inserted.

2. *Conditions Specifically Affecting the Scores of One Racial Group*

a. *The Whites.* The factor which has operated to depress the scores of the white children relative to the Negroes' scores was the general low absolute level of scores on most of the questions. We have discussed previously the fact that differences in favor of the white children appeared mainly in the case of the high-scoring questions. This results, in part, from the fact that any answer, no matter how poor, was assigned a score of "1," and so no differentiation was obtainable where all the answers sprang from nearly complete or complete ignorance of the phenomenon under consideration. Another reason for the relatively poor showing of the white children on the low-scoring questions was the tendency for the Negro children to make fewer omissions than the whites. Thus, no matter how poor the answer, it would be scored as "1," while the omitted answers were assigned a zero score. This is a qualitative rather than a quantitative difference, and has been discussed most fully under that heading.

It might be well to point out that this factor does not present as serious a difficulty as might at first be imagined. The fact that the white children were low-scoring on the same questions on which the Negro children did poorly has been emphasized before (p. 22), and it was concluded that this served to strengthen the conclusion that the two groups were from the same universe of discourse.

b. *The Negroes.* There are three general factors which may have operated to depress Negro scores as compared to those of the white children, and which must be taken into account in formulating our conclusions.

First, all tests were administered by a white experimenter. This may have depressed the Negroes' scores, although we cannot be certain that it did. The tentative results found by Canady (6) do not indicate any clear effect upon intelligence test scores by the race of the examiner.[5] Since Canady's experiment was conducted in the Chicago area, we cannot predict what the effect might have been in the South. One suspects that the presence of the white examiner may have helped, rather than hindered the Negroes, since it might have impelled them not to make omissions. This statement is pure speculation, however, and is included to demonstrate that the hypothesis that the race of the examiner helped the Negro children in our experiment is just as plausible as the contrary hypothesis. Most probably, any effect which might have been present was small. Certainly, the Negro children appeared to cooperate eagerly, and showed no apprehension of the white experimenter, although such observations are notoriously inaccurate.

Second, the Negro children may have suffered from a comparative language handicap. Since the answers were written, this possibility requires serious consideration. None of our subjects was illiterate, of course, as is readily apparent from their presence in the third and higher grades. How important this factor might be is impossible to estimate. It is probably not as serious as it would have been had our sample been drawn from a rural district. In any event, this difficulty is insuperable, since it is becoming increasingly apparent that performance tests are not only not culture free, but may actually have a heavier culture loading than the verbal tests. This is amply discussed by

[5] Klineberg (12, p. 68) does not interpret Canady's results as do we. Both Canady himself and Machover (27) conclude that the race of the examiner has no effect. We have calculated the average change from situation to situation, as contained in Canady's tables, and if we read his figures correctly, the actual shift shown by both the white and the Negro groups was virtually zero (white = -3.32, Negro = $+1.98$, where a plus means a higher score under the Negro examiner). We are inclined to believe that Klineberg's interpretation is a misunderstanding.

Machover (17), and has recently been demonstrated again by Alper and Boring (1), who have used the old Army Alpha and Army Beta data from World War I in their analysis. Perhaps the greatest difficulty in our experiment lay in the task of interpreting what the children, both white and Negro, had written. Such words as "preass" and "grapitation" arose to challenge the judges' ability to ascertain the children's meanings.

Third, the problem of schooling, and attitudes toward schooling must be considered. The topic of the Negro school has been discussed many times elsewhere. Closely related to the problem of the school itself is the probable lower motivation of the Negro pupils. It is not our purpose to enter into a sociological discussion, but it must be pointed out that Negro children could not be expected to be as eager to learn theoretical points about physics and chemistry (which would enter into adequate answers to our questions) as the white children. There is no particular hope for the average Negro child that obtaining an education will improve his economic and social status, and so he is not likely to make an eager scholar.

How much these factors relating to the school situation, and the related aspects of the cultural milieu may have affected our results is a matter for speculation. If the results of Peterson and Lanier (19) are applied here, it might seem that these factors are exceedingly important. On their "rational learning" tests, New York Negro children made only half as many errors as the Nashville Negro children. This does not mean, of course, that the New York subjects were twice as efficient as the Nashville group, but it indicates that the difference was appreciable. It would be unwise to assume that our investigation was affected in such large measure. Since our results, for both races, are quite similar to those obtained by Deutsche (8), to assume such an extreme effect would also require us to assume that a New York Negro group would perform much better than her Minnesota sample. Although this is possible, it does not seem likely.

3. *Conclusions*

Despite the limitations which we have discussed above, some positive statements may be made concerning our results. It will be remembered that our primary interest in conducting this investigation was the discovery of the relative number of superstitious and supernatural answers given by the Negro children as compared to the white children. In addition to the answer to this primary question, we have found certain other relationships which have been considered in some detail.

Quantitatively, the Negro children were found to be retarded in a small degree, perhaps about 10%. It was shown that the scores of the Negro children were related more closely to school grade than to age, and it was suggested that the factor of schooling was important in causing the apparent retardation. The white children, on the other hand, showed such a high relationship between age and grade that partial correlations revealed the effect of scholastic standing less clearly.

Qualitatively, much the same situation obtained. Certain trends in the type of answer given at the various age levels were interpreted as indicating comparative retardation of the Negro children. When grade by grade comparisons were made, the picture was not so clear. Much of the apparent retardation disappeared, and the Negro children did not appear to be inferior in such great degree.

Needless to say, our results cannot be interpreted as indicating any innately slow rate of mental development in the Negro child. As far as the quantitative and qualitative results which we have obtained are concerned, the differences are genuinely small. In view of the work in other fields of mental ability (*cf.* Klineberg, 12), we are inclined to consider any native difference as slight or non-existent. Certainly, similarities outweigh differences, and the differences which do exist are not too large to be explained very readily on environmental grounds, especially when such grounds so abundantly exist.

The answer to the primary question in our investigation is clear and unequivocal. The Negro children did not, despite the fact that our sample was taken from the Deep South, tend to resort to non-material explanations of physical phenomena, either as compared to our white sample, or in absolute number. Within the limits of our method we have found no evidence that the Negro children had a "... high interest in superstition" (12, p. 19), which operated to handicap them in approaching a concrete situation in an objective way.

VIII. SUMMARY

Following, in general, the technique used by Deutsche (8) in her study of reasoning in children, we have collected written explanations of ten physical demonstrations from 134 white and 161 Negro children in grades 3, 4, 5, and 7 of the public schools of Tuscaloosa, Alabama.

The answers obtained were scored quantitatively for accuracy, and were subsequently divided into three major categories, material, non-material, and omitted and "don't know," with appropriate sub-categories within the first two of these.

It was found that our Negro sample was retarded in school grade, in quantitative score, and in development along the direction of the age trends within the sub-categories under the material heading. Very few answers, either from white or from Negro children, were classifiable as non-material.

It is concluded that:

(1) In view of the inequalities in scholastic and other opportunities for our two groups, the differences obtained were (a) less striking than the similarities, and (b) readily attributable to environmental causes, and

(2) The Negro children do not tend to be supersititious or supernatural in their approach to concrete situations, either as compared to the white sample, or in absolute number of responses.

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